EDGARTOWN HARBOR
MASSACHUSETTS

SURVEY
(REVIEW OF REPORTS)

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

MAY 1969

R- 9/69
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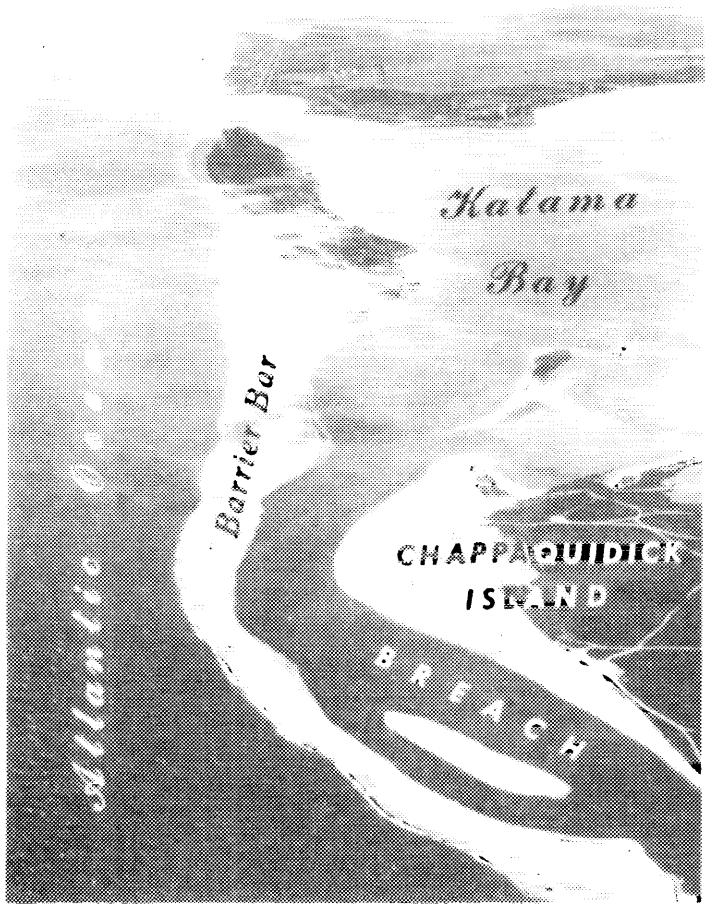
EDGARTOWN HARBOR, MASS. - LOOKING SOUTHWEST
16 SEPTEMBER 1968



FRONTISPIECE - LOOKING WEST ALONG KATAMA BAY BARRIER BAR
16 SEPTEMBER 1968

SYLLABUS

The Division Engineer finds that the general navigation facilities at Edgartown Harbor and the shoal water conditions at adjacent Katama Bay, Massachusetts are inadequate for the recreational boating fleets and the commercial shellfishing industry, respectively, both existing and prospective. He finds that sufficient benefits would be realized by both these major interests to warrant Federal participation in further improvement. He recommends, therefore, that the existing project for Edgartown Harbor be modified, and considers the optimum modification at this time to consist of (a) construction of a high-level (+16 feet above mean low water) barrier beach extending along the southerly side of Katama Bay from the main island of Martha's Vineyard toward but not connected to Chappaquiddick Island (a natural inlet will be left at Chappaquiddick Island), and (b) dredging of a 10-acre anchorage, 6 feet deep, adjacent to Chappaquiddick Point at Edgartown Harbor.

The total estimated construction cost for the project is $1,855,000 No additional aids to navigation are required.

The project is recommended subject to certain requirements of local cooperation, including the requirement that local interests contribute in cash 5.4 percent of the construction cost, presently estimated at $100,000. The net cost to the United States is $1,755,000 for construction and $63,000 for annual maintenance. The annual benefits are estimated at $587,600. The benefit-cost ratio is 3.6.

R 10/69
R 9/69

EDGARTOWN HARBOR, MASSACHUSETTS

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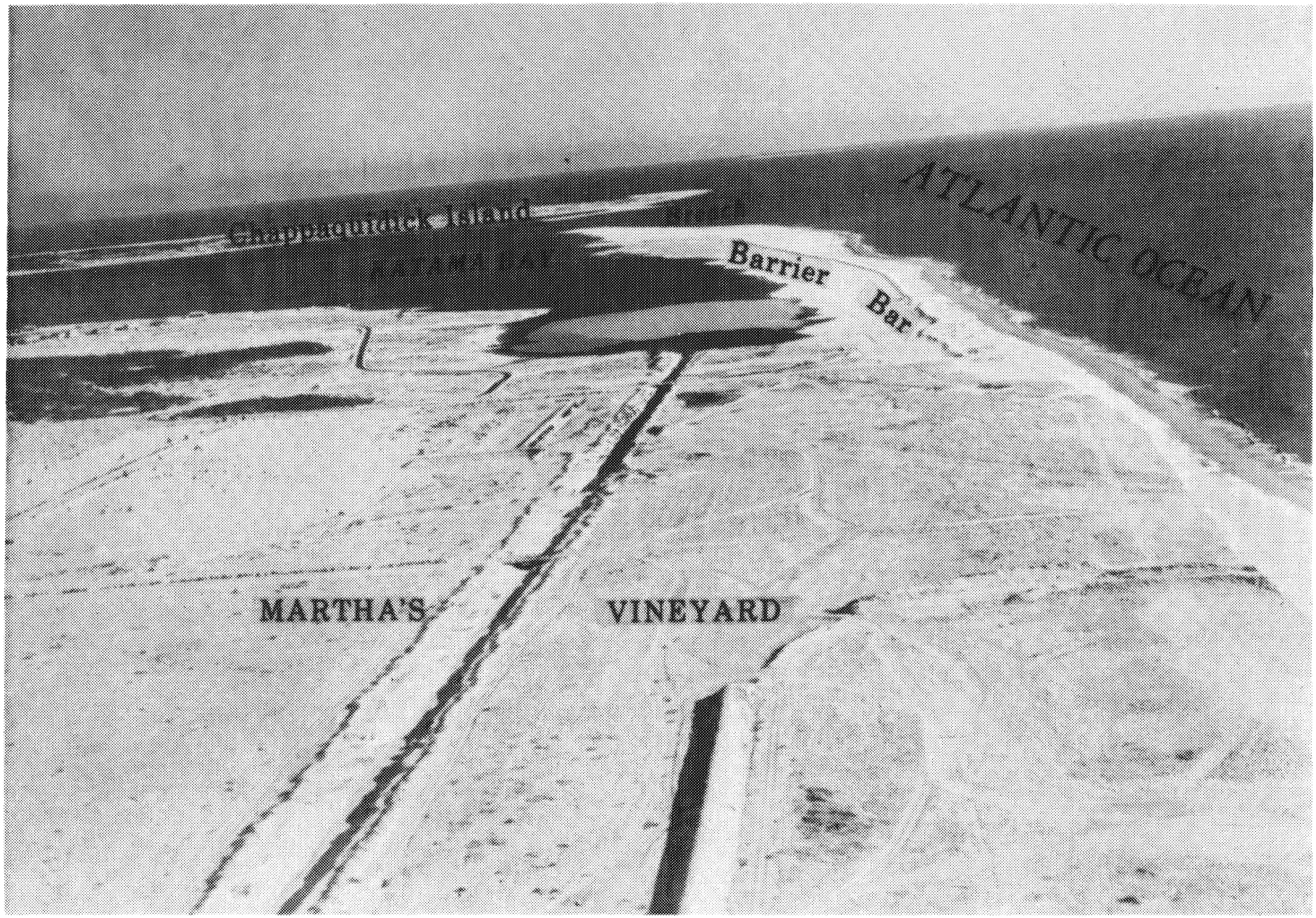


LOOKING EAST ALONG KATAMA BAY BARRIER BAR - 4 APRIL 1963

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

IN REPLY REFER TO
NEDED-R

23 May 1969

SUBJECT: Survey (Review of Reports) on Edgartown Harbor, Martha's Vineyard, Massachusetts

Chief of Engineers
ATTN: ENGCW-PD

AUTHORITY

1. This report is submitted in compliance with a resolution, adopted 29 February 1960, by the Committee on Public Works of the United States Senate. The resolution reads as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on Edgartown Harbor, Massachusetts, published as Senate Committee on Commerce Print numbered 10, Seventy-fourth Congress, second session, with a view to determining if further improvement in the interest of navigation, including the correction of the effect of the breach at the south end of Katama Bay, is advisable at this time."

2. The Chief of Engineers, in a letter dated 16 March 1960, assigned the review report to the Division Engineer, New England.

PURPOSE AND EXTENT OF STUDY

3. This study has been made to determine the need and economic justification for modifying the existing navigation project for the harbor in accordance with the desires of local interests. In preparation of the report, extensive field work, consisting of hydrographic surveys, probings, and field reconnaissance was accomplished. This

work was supplemented by analyses of available maps, charts, aerial photographs, commercial statistics and other data pertaining to the waterway. A public hearing was held on 1 September 1960 in Edgartown, Massachusetts. Information obtained from the hearing is described later in this report under "IMPROVEMENTS DESIRED." Subsequent contacts with local interests have revealed further information which has been incorporated into the study.

DESCRIPTION OF NAVIGATION CONDITIONS

4. Edgartown Harbor is located on the east side of Martha's Vineyard, the largest of a group of islands off the southern coast of Cape Cod, Massachusetts. The harbor consists of two components, an outer and an inner harbor. The outer harbor is a natural bay formed by the northeast coast of Martha's Vineyard proper and the northwest side of Chappaquiddick Island, a small island to the east. The bay is relatively deep, with depths ranging from 20 to 34 feet for an average width of about 1-1/2 miles. This portion of the harbor is exposed to northerly winds.

5. The inner harbor, the locale of the major portion of boating and terminal facilities, is formed by a strait between the two islands. The strait extends from the outer harbor about 1,500 feet in a westerly direction, where it turns and proceeds southerly for about 8,000 feet into the head of Katama Bay. The width of the strait varies from 0.2 mile to 1.0 mile, with depths ranging from 16 to 35 feet throughout the center portion. Katama Bay covers an area of about 3 square miles with depths ranging from 1 to 19 feet, although most of the southern portion of it is less than 6 feet deep. Some areas are exposed at mean low water. The bay is separated from the open Atlantic Ocean on the south by a narrow barrier beach. At present, the bay and the ocean are connected by an inlet, roughly 500 feet wide, running east-west between the barrier beach and the shore of Chappaquiddick Island.

6. All depths mentioned refer to the plane of mean low water, as established by the U. S. Coast and Geodetic Survey for this locality. The mean range of tide off Wasque Point near the southerly opening to Katama Bay is 1.1 feet and at Edgartown Harbor, 1.9 feet. The locality is shown on U. S. Coast and Geodetic Survey Chart No. 346; on U. S. Geological Survey Quad Sheet, Edgartown, Massachusetts; and on the maps accompanying this report.

TRIBUTARY AREA

7. The harbor itself lies entirely within the town limits of Edgartown, which may be considered the immediate tributary area. However, numerous summer residents of nearby towns base recreational boats in the harbor to take advantage of its attractive facilities. Therefore, the harbor's tributary area may be considered to range over the entire area of Martha's Vineyard.

8. Much of the economy of the island is oriented toward the summer recreational business. Total employment on the island in July 1966 was 2,106 as compared with 988 in November 1966. The service and trade industries account for more than half of all employment. Only 7 manufacturing firms operated on the island in 1966, reporting employment of 46 persons in November. At Edgartown, commercial fishing is an important industry. In 1967, landings of 2,043 tons of shellfish and 10 tons of fresh fish were reported. The shellfish landings were the highest of any Massachusetts port except New Bedford and Fairhaven Harbor, a major commercial port, where 4,398 tons of shellfish were landed in 1967.

9. The population of Edgartown was reported by the 1965 Massachusetts State Census as 1,513, or about 25% of the island total. Equalized real estate valuation of the town in 1968 was $32,000,000, which is 31% of the valuation for the entire island.

10. The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority operates daily ferry boat service between terminals in the communities of Vineyard Haven and Oak Bluffs on the island and Woods Hole, Massachusetts on the mainland. Bus service to Boston is also available from this point. Regularly scheduled airline flights are provided to Martha's Vineyard from Boston, New York and Hyannis. Charter, private plane, and air taxi services are available in addition to the airline.

BRIDGES AFFECTING NAVIGATION

11. There are no bridges in the area considered in this report.

PRIOR REPORTS

12. Several reports, dating back to 1826, have been made on this harbor. Prior to 1888 the reports all pertained to establishment of an opening through the barrier beach bordering the southerly end of Katama Bay. Mariners desired such an opening for quick access to the fishing grounds and vessels in distress. Failure of a Federal effort to create the desired opening is described in the Reports of the Chief of Engineers for the years 1874 and 1875. Pertinent data with respect to the reports which recommended the existing project in Edgartown Harbor are listed below:

Scope and Date of Report	Work Considered	Recommendation
House Executive Document No. 59, 51st Congress, 1st Session December 14, 1888	Dredge Middle Ground to 10 feet. Construct breakwater and icebreaker near lighthouse in outer harbor.	Favorable
Senate Committee Print, 74th Congress 2d Session March 14, 1936	Channel 17 feet deep, 150 feet wide, from Outer to Inner Harbor with widening at bend. Deepen Middle Ground to 12 feet.	Favorable

EXISTING CORPS OF ENGINEERS PROJECT

13. The existing project was authorized in 1937. It provides for a channel 17 feet deep, generally 150 feet wide from the Outer Harbor to deep water in the Inner Harbor, suitably widened at the bend inside the Inner Harbor, and removal to a depth of 12 feet of the entire Middle Ground shoal inside and east of the entrance to the Inner Harbor. The total length of the project channel is about 1 mile, including the entrance channel.

14. The project was completed in 1939. Total costs were $45,614.92 for new work. The harbor has not required maintenance since completion of the project.

LOCAL COOPERATION ON EXISTING AND PRIOR PROJECTS

15. The River and Harbor Act of 26 August 1937 authorized the project subject to the requirements that local interests contribute in cash $10,000 toward the cost of the project and furnish, free of cost to the United States, suitable areas for disposal of dredged materials. These requirements were met.

OTHER IMPROVEMENTS

16. Several improvements for general navigation and for enhancement of the shellfishing industry have been made in recent years. The Commonwealth of Massachusetts, in February 1967, dredged an area along the Edgartown shorefront from a point just north of the Edgartown Yacht Club, southwesterly to the Town Beach, a distance of about 800 feet. The area was dredged to a depth of 6 feet below mean low water with 1 foot overdepth allowance. The cost for the work was nearly $62,000, of which the Town contributed almost $9,000. In August 1968 the Public Access Board of the State Department of Public Works completed a boat launching facility on the southwest side of Katama Bay just south of Katama Point. The facility includes an access road, parking area, and a 20-foot wide paved launching ramp. The cost of the improvement was in excess of $50,000. The State and Town expended in excess of $2,300 in 1966 for the protection and propagation of shellfish in Town waters. During the years subsequent to the most recent breach in the Katama Bay barrier beach (1956), the Town expended a total of $21,669 for sand fencing and dune grass in an effort to rebuild the barrier beach. Of this amount, $6,655 was for the materials. In addition to the general navigation facilities, the Town continues to maintain and improve its waterfront structures.

TERMINAL AND TRANSFER FACILITIES

17. There are two public wharves in the town. One, the steamboat wharf, was formerly used for passenger and freight traffic from the mainland. This commerce is now handled in the neighboring communities of Vineyard Haven and Oak Bluffs. The wharf is open to all on equal terms. In addition, there is a commercial wharf and a yacht club wharf where recreational boats receive services and supplies. These wharves are ample for the needs of both existing

and prospective fleets. The shellfish are landed at the two public facilities. Private wharves serving individual property owners number between 30 and 35. All of the wharves are of wood pile and timber construction and appear in excellent condition.

IMPROVEMENTS DESIRED

18. For the purpose of determining the nature and extent of local desires for navigational improvement, a public hearing was held in Edgartown, Massachusetts on 1 September 1960. Among those present were representatives of yachting associations, local town officials and interested citizens.

19. Various proposals were tendered for improvement, each of which local interests claimed would correct existing navigation inadequacies in the harbor. The specific items are described in the following subparagraphs.

a. Provide a 12-foot deep anchorage area of about 39 acres in the inner harbor. Its location would be immediately inside the entrance and on the east side, adjacent to Chappaquiddick Island. In addition, it was suggested that about 20 acres of the point on Chappaquiddick Island near the harbor entrance be deepened to 6 feet to reduce tidal currents in that area.

b. Close the opening in the sandspit on the southerly side of Katama Bay. It was claimed that the opening causes rapid currents in the strait and creates a navigational hazard. Sand to close the opening would be dredged from Katama Bay, thereby rehabilitating the shellfish habitat. In addition, deepening of shoal areas would make the bay more usable for recreational boating.

c. Deepen the channel to Caleb Pond, then continue through the pond and the opposite shore to Nantucket Sound. Supplementing this channel would be breakwater protection on the seaward end.

d. Dredge the shoal extending from Snow's Point to lessen tidal currents in that area.

e. Provide erosion protection in the Eel Pond area.

20. Each of the above requests was given due consideration in the study. Preliminary examination of the erosion problem in the Eel Pond area indicates that the problem may be worthy of further consideration. This possibility will be explored further under the small beach erosion project authority.

EXISTING AND PROSPECTIVE COMMERCE

21. The total commerce landed at the port consists chiefly of shellfish. As stated above, landings of 10 tons of fresh fish and 2,043 tons of shellfish were reported in 1967. For the past 10-year period, this commerce has remained stable, averaging 1,850 tons. In 1960, 4,000 tons of shellfish were landed. Based on an official weight of 60 pounds per bushel the average annual landings of 1,850 tons for the past ten years amounts to over 60,000 bushels. Most of the commercial shellfish production comes from Cape Poge Pond, and Sengekontacket Pond, which lies between Edgartown and Oak Bluffs. One transportation service operates in the harbor, i.e., the Chappaquiddick Ferry. A motorized barge, it has space for two automobiles and their passengers and crosses the harbor between Edgartown and Chappaquiddick Point. Passengers carried in 1967 numbered 25,736.

VESSEL TRAFFIC

22. Recorded vessel trips in 1967 amounted to 42,570, which is rather low by historical comparison. In 1966, a total of 61,559 vessel trips were recorded. These figures for the most part represent trips of the Chappaquiddick Ferry. Approximately 5,500 of the 1966 trips were made by small boats engaged in shellfishing, principally in Cape Poge Pond. These boats are of shallow draft and experience few navigation difficulties. Edgartown Harbor is used extensively for recreational boating.

DIFFICULTIES ATTENDING NAVIGATION

23. Strong tidal currents in the inner harbor, occurring during the years subsequent to a breach in the Katama Bay Barrier beach in 1954, motivated local interests to seek review of the existing Corps of Engineers project. These breaches occur periodically during hurricanes and other severe storms. Navigation in the harbor channel under these conditions is hazardous for sailboats and other recreational craft. Numerous instances of damage attributable to the currents were reported. Anchorage space was reduced, as the currents required that moorings be placed further apart than

in other recreational harbors. To find anchorage and avoid the currents, the larger boats were forced to anchor in the outer harbor, exposing them to damage from easterly and northeasterly storms. Prior to such storms, local interests cited instances of general exodus from the harbor to mainland ports.

24. Analysis of all available information indicates that the currents are undoubtedly associated with breaching of the Katama Bay barrier beach. Hydraulic communication is thus established between the Atlantic Ocean and Nantucket Sound which have dissimilar tidal characteristics. Published tide data show the mean ranges of tide at Edgartown Harbor as 1.9 feet with a spring range of 2.3 feet and off Wasque Point on the southeast tip of Chappaquiddick Island as 1.1 feet with a spring range of 1.4 feet. The high and low tides do not occur at the same time at each of these points. There is a phase difference of 2 to 3 hours. This means that while it is high tide at Edgartown, nearly a half-tide may exist at Wasque Point. This results in a head differential, which can be up to 1 foot under extreme tide conditions.

25. Historically, a storm creates a breach at the middle or western section of the barrier beach, as illustrated by FIGURE 1 taken from Coast and Geodetic Survey Chart 346, revised 25 August 1958. The breach occurs at this location because the hydraulic grade line between the Atlantic Ocean and Nantucket Sound is relatively short and steep. Correspondingly, the tidal currents in Edgartown Harbor are strong, as noted by local residents. Under the influence of easterly littoral transport along the south shore of Martha's Vineyard, the breach migrates to the east. As it does so, the hydraulic grade line lengthens and flattens, the tidal currents diminish, and the breach narrows in width. When it reaches Chappaquiddick Island, it wraps itself around the south shore of the island as littoral transport extends the bar easterly. Sometime in the future, a storm will create a new breach at the westerly end of the barrier beach, the existing easterly breach will then close, the new breach will move gradually easterly, and thus the cycle will be repeated.

WATER POWER AND OTHER SPECIAL SUBJECTS

26. Hurricane "Carol" in 1954 caused the highest flood levels on record for the Edgartown Harbor area, 7.6 feet above mean sea level. The flood elevations for the hurricanes of 1938 and 1944

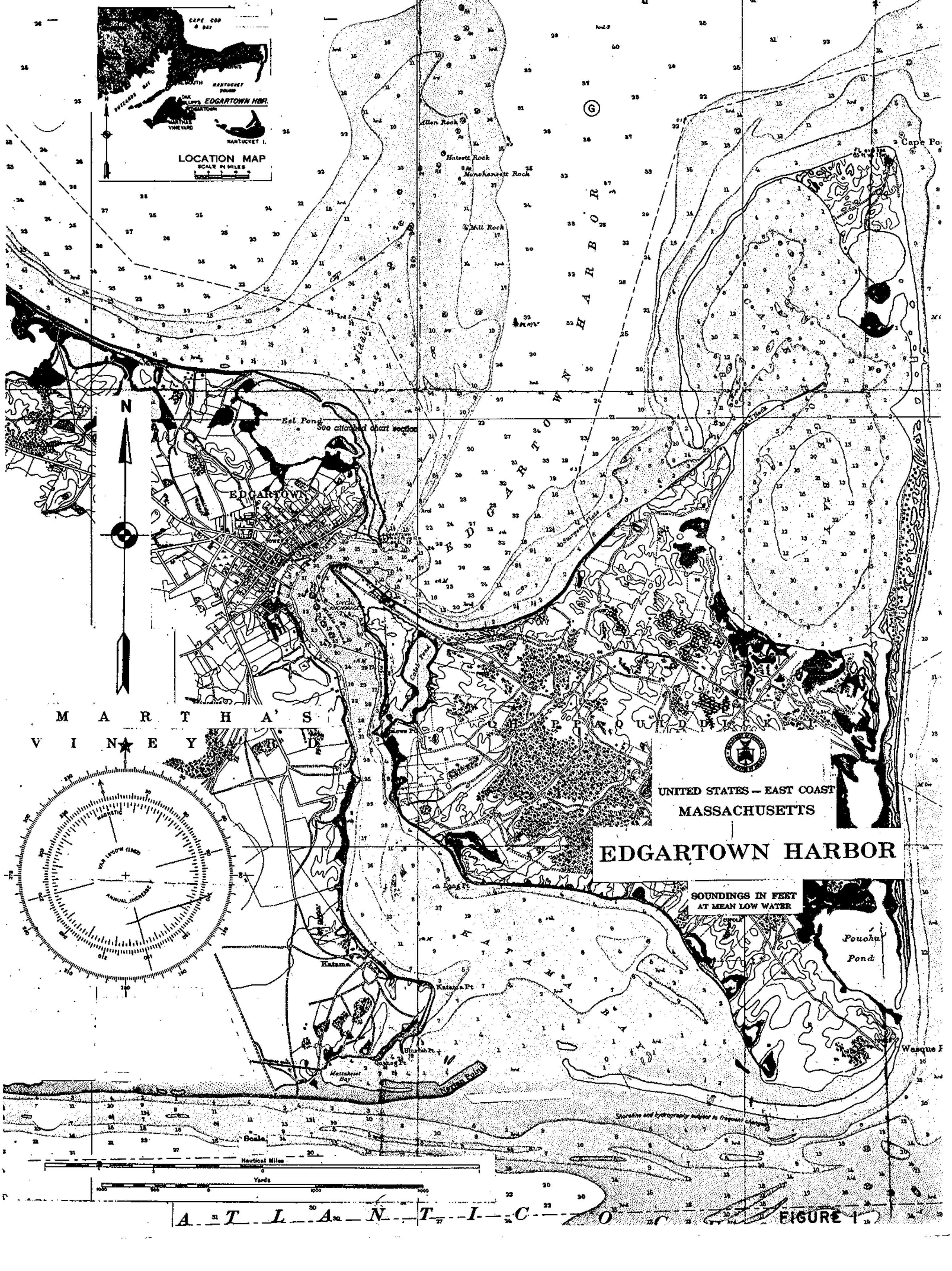

LOCATION MAP
EDGARTOWN HBR.
NANTUCKET I.
Allen Rock
Hatsett Rock
Mill Rock
Eel Pond
See attached chart section
EDGARTOWN
EDGARTOWN HARBOR
CAPE POGE BAY
MARTHA'S VINEYARD
CHAPPAQUIDDICK I.
UNITED STATES — EAST COAST
MASSACHUSETTS
EDGARTOWN HARBOR
SOUNDINGS IN FEET AT MEAN LOW WATER
KATAMA BAY
Katama
Katama Pt
Pouoha Pond
Wasque
Shoreline and hydrography subject to frequent change
Nautical Miles
Yards
ATLANTIC OCEAN

FIGURE 1

were somewhat lower. Damages at Edgartown Harbor during the 1954 storm were estimated at $135, 000. These damages resulted from tidal flooding at Edgartown Harbor rather than direct wave or wind forces from Katama Bay. Therefore, construction of the barrier beach at Katama Bay is not expected to result in any significant reduction in tidal flood damages.

27. Pollution is an important consideration. Recently approved State water pollution control standards require that the waters of Edgartown Harbor and Katama Bay be maintained at a high level of quality. Tidal currents cleanse the harbor of raw sewage being discharged from private and municipal outlets as well as the growing number of boats equipped with flush toilets. To prevent degradation of water quality, the Federal Water Pollution Control Administration feels that the existing breach next to Chappaquiddick Island should be left open. Plans call for a sewerage system and secondary treatment plant to be in operation during 1972 serving the built-up portion of Edgartown. Once this plant is in operation, the breach could be closed, providing that water quality in the harbor could be maintained. Comments of the FWPCA are included in APPENDIX D.

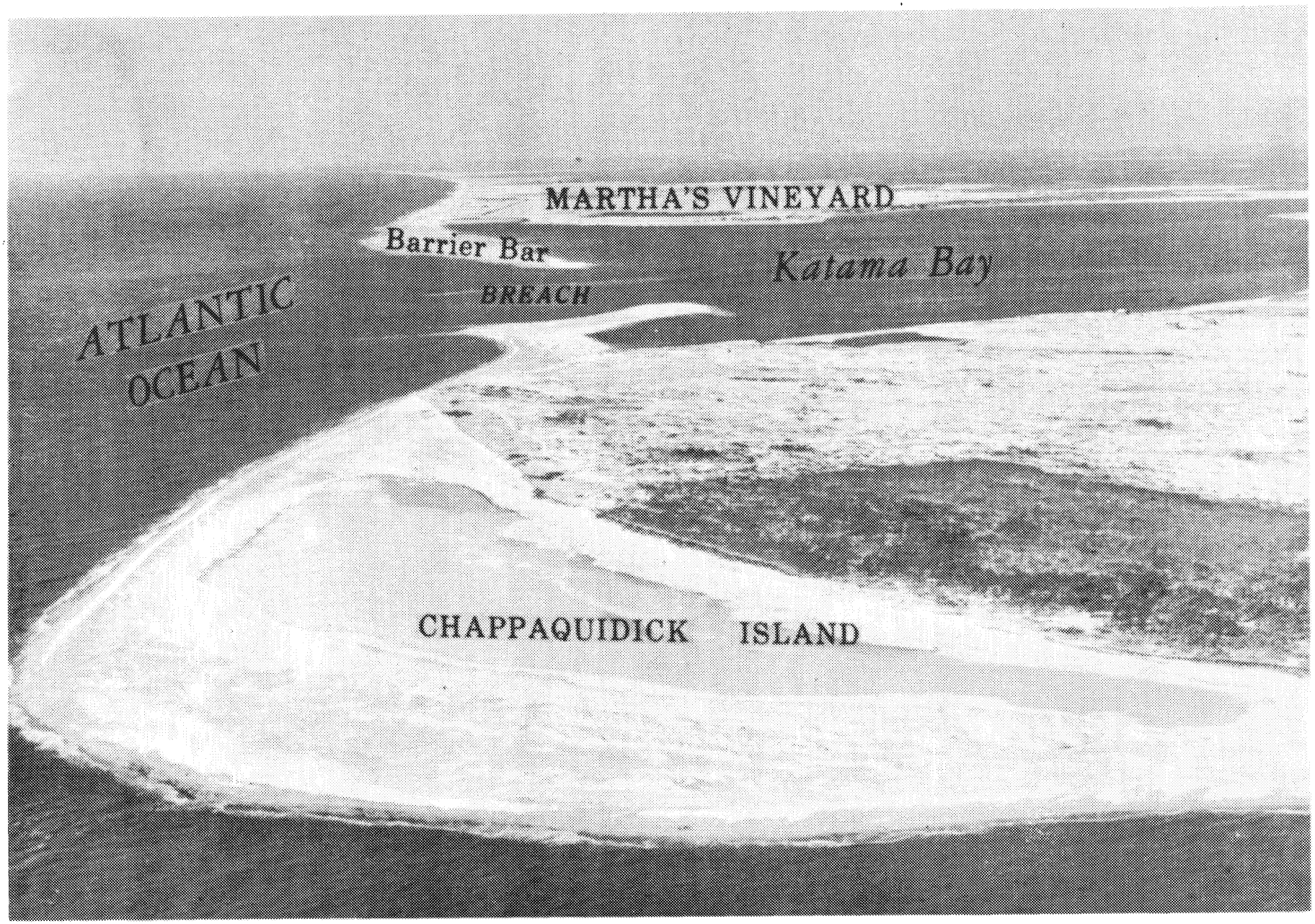
SHELLFISHING

28. As breaches have occurred over the years, the southern part of Katama Bay has become shoaled with sands which are shifted about by tidal currents and the inlet migration process. The shifting sands have damaged shellfish habitat which once yielded significant harvests. In 1907, the hard clam production was 20, 000 bushels and engaged about 70 commercial shellfishermen. Today, virtually no clams are produced in Katama Bay on a commercial basis because the amount of good shellfish habitat in water over 8 feet deep is insufficient to attract operators with the necessary equipment. The U. S. Fish and Wildlife Service estimates that use of material from shoal areas to stabilize the barrier beach would develop moderate to high value shellfish habitat on an estimated 570 acres of bottom. At an average annual production rate of 200 bushels per acre, the potential hard clam harvest is 114, 000 bushels per year. Details are given in the U. S. Fish and Wildlife Service report in APPENDIX C.

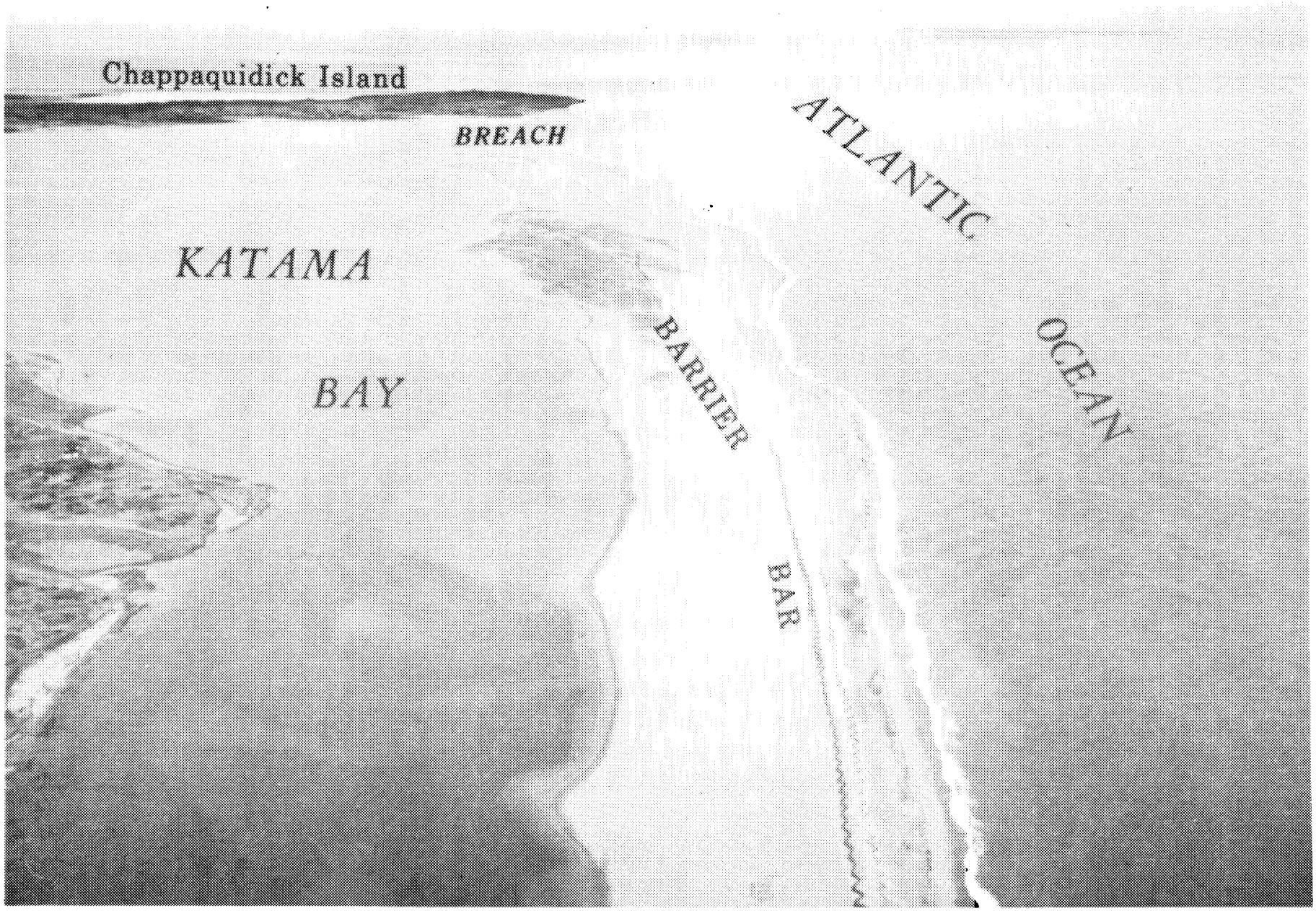
29. At the public hearing, it was suggested that tidal currents could be reduced and additional anchorage could be provided by dredging shoal areas at Snow's Point and Chappaquiddick Point. The effectiveness of these proposals is doubtful. Deepening of the channel will increase the hydraulic radius locally, thereby reducing the retarding effect of friction on the currents. An increase in current rather than a decrease is possible. Further, no control is exerted on the basic cause of the excessive currents, direct linkage of the Atlantic Ocean and Nantucket Sound. Another suggested means of reducing current velocity was excavation of a second channel from the outer harbor through Caleb's Pond to the inner harbor. This proposal would involve construction of a bridge, jetties to stabilize the entrance channel, and dredging a channel. Preliminary cost estimates indicated that this improvement would not be economically justified. Consideration was given to providing permanent closure of the breach in the Katama Bay barrier bar, and to providing additional anchorage area at Edgartown.

30. Early in the study, it appeared that the most economical means of reducing tidal current velocities in Edgartown Harbor would be by placement of an inner barrier across the head of Katama Bay from Long Point to Katama Point. This plan was opposed by the U. S. Fish and Wildlife Service. With Katama Bay uncoupled from Nantucket Sound, its hydraulic behavior would be identical to that of Edgartown Great Pond. The Fish and Wildlife Service believes that littoral drift would quickly close the opening to the Atlantic, and fresh water inflows would turn it into a brackish pond, disrupting the ecological balance. The inner barrier would also reduce the tidal prism traversing Edgartown Harbor, creating potential for pollution and shoaling problems. These considerations made the inner barrier less desirable than strengthening the barrier beach.

31. Local interests requested that additional anchorage be provided by dredging 39 acres, 12 feet deep, in the inner harbor southerly of Chappaquiddick Point. Investigation of the hydrographic survey map (see PLATE 2) for the entire area extending from the outer harbor southerly to the head of Katama Bay reveals that nearly all of this area is at or well in excess of 12 feet deep. The only shoal area is located adjacent to Chappaquiddick Point. Dredging this area to



LOOKING WEST ALONG KATAMA BAY BARRIER BAR - 20 DECEMBER 1960



LOOKING EAST ALONG KATAMA BAY BARRIER BAR - 20 DECEMBER 1960

within a safe minimum, say not closer than 200 feet from shore, would result in an additional 10 acres of anchorage.

32a. Need for the dredged anchorage was examined in view of natural deep-water anchorage available in areas lying southerly of Edgartown. These areas were considered unattractive to the potential user for the following reasons. They are located in the vicinity of the narrowed neck connecting Edgartown Harbor and the northerly portion of Katama Bay. Due to the constricted channel cross-section, tidal current velocities for this narrowed area shall remain somewhat troublesome even if the breach is closed. Town officials have indicated that only the larger visiting craft use the area as they can cope with the tidal currents which exist at present. Further, and more important, the areas are remote from shore facilities. Owners of most large craft have small power skiffs for shore access; other owners without power would have to row a long distance to shore facilities under occasionally adverse conditions. Protected anchorage to accommodate the smaller locally-based craft is needed near shore facilities.

32b. Marina construction as an alternative to dredged anchorage was considered and rejected. The Town owns a negligible amount of shorefront property upon which it could construct a public marina, and profitability of a private marina is doubtful. Limited use of a marina is expected to provide a monetary return insufficient to justify the high investment required for property acquisition, facility construction, and dredging.

32c. Consideration was given to dredging the desired area to a 12-foot depth as desired, and to a 6-foot depth which is considered a minimum need for recreational craft. It was found that the cost to provide the 12-foot depth would be over three times that for the 6-foot depth. Examination of the fleet composition at Edgartown Harbor (see TABLE 2, Page 22) shows that most of the fleet is composed of outboards, inboards, stern drives, and small cruisers. These craft draw from 3 to 5 feet. With an allowance of 1 - 2 feet under the keel for safety purposes, it is considered that a 6-foot anchorage would provide economically for these craft in an area away from currents and traffic. The deeper draft vessels, many owners of which have power skiffs to use between the boat and shore facilities, can move safely and properly anchor in the deep water areas. An

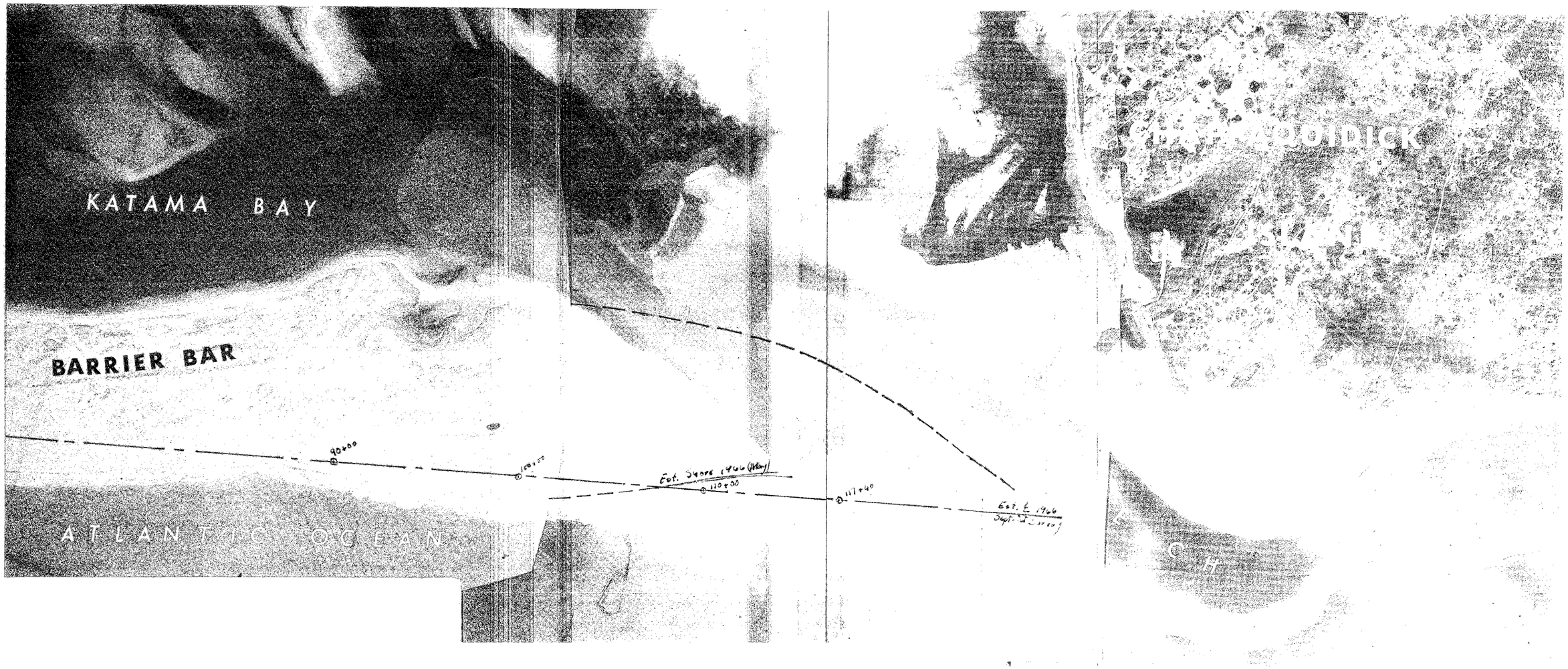


PHOTO NO. 1. LOOKING NORTH ACROSS KATAMA BAY BARRIER BAR, 23 OCTOBER 1967

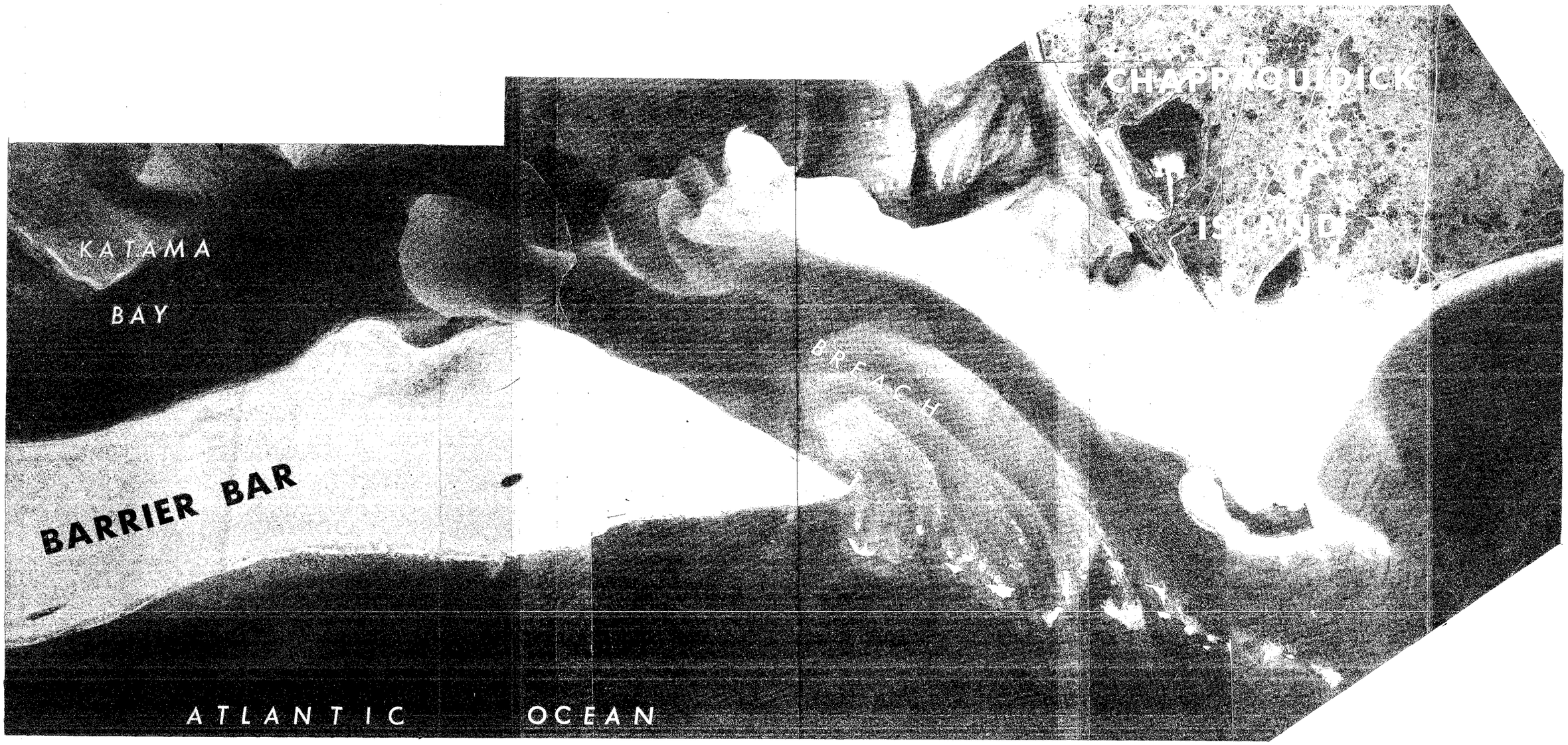


PHOTO NO. 2. LOOKING NORTH ACROSS KATAMA BAY BARRIER BAR, 23 MAY 1966

8-foot depth would not provide for a sufficient number of deeper draft craft ot justify the incremental expenditure. Therefore, a 10-acre anchorage, 6 feet deep, being considered as maximizing net benefits, was selected for inclusion in the plan of improvement.

33. Three plan s of improvement for the barrier beach were considered: (A) Building an artificial high sand dune from high ground on Martha's Vineyard to Chappaquiddick Island; (B) same as (A), but with retention of the existing breach at the easterly end, allowing it to seek self-stabilization or natural closure; and (C) same as (A), but with a stabilized opening about 500 feet wide at the east end involving a jetty and system of groins.

34. Based on a comparison of the benefits and costs associated with the three plans, Plan (B) was selected as the proposed plan of improvement. The essential purpose is protection of the middle and westerly sections of the barrier beach against future breaching. Complete closure of Plan A would yield few additional benefits since tidal currents at Edgartown Harbor are nominal when the breach is next to Chappaquiddick Island. Also, the U. S. Fish and Wildlife Service foresees no increase in shellfish benefits to result from complete closure. In 1873 and 1921, artificial openings were attempted at the request of local interests after nature had closed existing breaches. It was contended that reduced water circulation was detrimental to

shellfish growth and that diminished currents were allowing shoals to build in the harbor. The U. S. Fish and Wildlife Service reports (see APPENDIX C) that the principal reason for the loss of shellfish habitat is the recurring breaches, which result in great quantities of sand entering the bay. These sands, which are subjected to tidal currents, shift and thus prevent establishment of shellfish beds. A present result of flow through the breach is the flushing action it provides in removing pollution from the harbor. The Federal Water Pollution Control Administration states (see APPENDIX D) that a complete closure dike would probably result in significant water quality degradation, while the Department of Health, Education and Welfare (see APPENDIX D) doubts that a narrow breach at the east end of the barrier would do much to offset the pollutional load that might occur. In view of the high rates of shoreline recession and littoral transport, it was found that stabilization of an opening as proposed in Plan C would not be economically justified. The costs for jetties, revetment and sandfill would by far offset the relatively small beneficial results. Also, while a navigation opening was artificially attempted in the late 1800's and early 1900's, an opening for navigation is not needed or desired at the present time.

35. In the decision to leave the existing breach open, consideration was given to the high rate of erosion along the south shore of Chappaquiddick Island. During most of the project life, the breach would take the form of a narrow inlet running parallel to the Chappaquiddick shore, with the barrier beach acting as an offshore bar providing protection against wave attack. Details concerning the formulation of Plan B are given under "PLAN OF IMPROVEMENT."

36. The foregoing project formulation reflects due consideration of cost and benefit variables, thus resulting in a project which maximizes net benefits.

PLAN OF IMPROVEMENT

37. Photo 1 shows an aerial view of the barrier beach taken on 23 October 1967 marked to show the base line of a profile survey made in September and October 1966 (the latter survey is shown on PLATES 3 and 4.) A dune structure is proposed from high ground near Station 10+00 to the vicinity of Station 110+00. Records indicate that past openings near Chappaquiddick Island were 1,000 feet

and more in width which is roughly the present width of the breach near Station 110+00. Since tidal flows are limited by the energy gradient and the narrows at Edgartown Harbor, it is unlikely that an opening much wider than 1, 000 feet would occur at the east end of the barrier. Therefore, revetment at the head of the structure will not be required.

38. Erosion of the south shore of Chappaquiddick Island should be curtailed even though the existing breach will be left open. Photos 1 and 2, taken on 23 October 1967 and 23 May 1966, respectively, show that a bar has extended approximately 1 mile easterly from Station 110+00 and parallel to the shore of Chappaquiddick Island in about 1-1/2 years. A large berm which has built out from shore near the tip indicates that sand is passing across the breach to nourish the island beach. Should a storm scour away the natural extension beyond Station 110+00, littoral drift will rebuild the bar in about 2 years.

39. Building the structure near the present shoreline will result in the least volume of fill material. However, future recession of the shoreline will require extensive stabilization measures such as a groin system or beach nourishment to prevent loss of the structure to erosive forces. As a more economical choice, the structure should be located somewhere between the expected location of the shoreline at the end of project life and the existing shoreline. The optimum location for the centerline of the structure is considered to be about 250 feet shoreward of the existing high waterline and will reflect a comparison between the amount of materials required during initial construction versus annual nourishment in order that the most efficient alignment is selected.

40. In order to design the dune structure, it is necessary to predict the maximum water level which reasonably can be expected. High water mark data taken in conjunction with a hurricane survey of the New England coast indicates that the highest known still water elevations in the Martha's Vineyard vicinity were generated by Hurricane Carol of 31 August 1954. PLATES B-10 and B-11 of the report, Hurricane Survey of Narragansett Bay Area, show a 50-year frequency of occurrence for Carol's tide flood levels and Carol is selected as the design hurricane. Transposing Carol closer to Martha's Vineyard, the design surge was calculated to be 8. 4 feet above predicted

astronomical tide, including rise in water level due to barometric pressure deficit. Assuming a normal tide range of 2.0 feet, the design storm tide is 10.4 feet above mean low water. For details, see APPENDIX A.

41. A dune profile is adopted similar to that developed during other studies for the south shore of Long Island. FIGURE A-1 shows a typical cross-section near the Martha's Vineyard end of the barrier beach. The crest width is 25 feet at 16.0 feet above mean low water and side slopes are 1:5 (1 vertical to 5 horizontal). At this location, the back slope enters Katama Bay and is flattened to 1:10 below elevation 5 feet above mean low water. Fronting the crest section is a 100-foot berm at 10.0 feet above mean low water which drops to grade at a slope of 1:5. The berm elevation is selected to approximate the storm tide elevation, in order to reduce wave runup and scour at the toe of the crest section. Crest elevation is designed to prevent overtopping by runup, thus avoiding the risk of erosion.

42. To build this structure, approximately 570,000 cubic yards of fill material will be required. All of this material is available from shoal areas in Katama Bay. Beach grass will be planted to stabilize the dune structure, and to assure that wind-blown sand, which also contributes to a substantial degree to the siltation of the Katama Bay shellfish beds, will be largely eliminated. The entire barrier is owned by Dukes County and is open to all for swimming, surf fishing and walking.

43. The Federal Water Pollution Control Administration states that approved water quality standards at this location require construction of a secondary sewage treatment plant in Edgartown by 1972. It observes that the proposed improvement would result in minimal effects on water quality. It recommends that the natural breach at the east end of the barrier bar be left open until a study can be made to determine whether the breach could be eliminated without having a detrimental effect on the water quality. The Department of Health, Education and Welfare has reported (see APPENDIX D) that it doubts the beneficial effects of a narrow breach at the east end of the barrier to offset pollution loads which might occur in Katama Bay with complete closure. The FWPCA has advised the Department of Health, Education and Welfare that the treatment plant may include a final

sand filter which would eliminate need for an outfall. It is expected that these problems will have been resolved prior to construction of the proposed barrier. However, to assure that all necessary requirements are met, an allowance in the annual charges is made to permit reopening the breach if it closes naturally.

44. In addition to the Katama Bay barrier, an anchorage 6 feet deep and 10 acres in area is proposed for Edgartown Harbor at Chappaquiddick Point. Development of this plan is described in paragraphs 31 and 32.

SHORELINE CHANGES

45. Shoreline and offshore depth change maps show that the south shore of Martha's Vineyard near Katama Bay has been receding since 1846 at an average rate of 8 feet per year (see PLATE 5). Erosion of the south shore of Chappaquiddick Island has been especially severe. Presumably, littoral material diverted to shoal areas in Katama Bay caused an even greater deficiency of supply along the Chappaquiddick shore, compounding the rate of shoreline erosion. During the same period of time, the east shore of Chappaquiddick Island has remained stable. Of interest, also, are the many configurations of the Katama Bay barrier beach over the years. Available historical information concerning the barrier beach is given in APPENDIX B.

46. As mentioned earlier, littoral transport causes breaches in the barrier to migrate in an easterly direction. No accurate estimate of the rate of littoral transport is possible; however, an approximation may be gained by estimating the sand accumulation at the eastern tip of the barrier beach. Comparison of aerial photographs taken 23 May 1966 and 23 October 1967 shows that a beach area of over 1 million square feet grew at the tip. Technical Report No. 4 of the Coastal Engineering Research Center cites a rule of thumb that 1 square foot of change in beach surface area equals 1 cubic yard of beach material. Using this relationship, this area represents accumulation of 1 million cubic yards over a 17-month period. Disregarding losses and seasonal effects, the indicated rate of littoral transport for the entire southerly shore of Martha's Vineyard is 600,000 cubic yards per year.

47. Just west of Katama Bay, where breaching has not complicated the erosion process, the only depth surveys shown were taken in 1888

and 1891-92. In this brief period, the estimated annual loss of beach material between land and the 13-foot depth was 16 cubic yards per foot of shore. This figure may be inflated by the effects of a hurricane in the period 1-13 September 1889, which caused high waves and tides. This would indicate an annual loss rate of 8 cubic yards per foot of shore. The resulting rate of material loss along the Katama Bay barrier beach is 80,000 cubic yards per year.

48. Assuming the rate of shore recession would continue at 8 feet per year, the total recession would amount to 400 feet during the 50-year project life. Thus, if the proposed barrier is placed along an alignment approximately 400 feet shoreward of its present alignment, no nourishment of the barrier, except for relatively small losses from winds, would be required. If the proposed barrier is construction along the foreshore, it could be assumed that 80,000 cubic yards per year would be lost.

49. With the centerline of the proposed barrier located about 250 feet shoreward of the present highwater line, as noted in paragraph 39, it is estimated on a proportional basis approximately 30,000 cubic yards of sand would be required annually for nourishment over the project life. This is considered reasonable and is the most economical location in view of anticipated continued development of the island generally and the island's shorefronts specifically, which will force residents to take measures to retard shorefront losses.

ESTIMATES OF FIRST COSTS

50. Material to build the barrier beach will be dredged from Katama Bay and placed on the barrier beach hydraulically. A mechanical plant will be used to grade the material to the design cross section.

Attainment of the exact cross-section for the barrier will not be possible; therefore, an allowance of 1 foot beyond the design section is made for the entire barrier length and the quantity estimate so reflects the allowance. Dredging in Katama Bay will be to depths not less than 4 feet nor more than 10 feet in accordance with the recommendations of the U.S. Fish and Wildlife Service. The anchorage at Edgartown will be dredged to a 6-foot depth with 1 on 3 side slopes and an allowance of 1 foot overdepth. The materials will be dredged by clamshell or dipper plant with removal by scow to approved offshore dumping grounds. Hydraulic dredging of the anchorage is not feasible as there are no nearby spoil disposal sites. The proposed barrier dike is not within economical pumping distance of the dredging site at Edgartown. The materials to be dredged, both in Katama Bay and at Edgartown, are ordinary materials consisting of mud, sand and gravel. The estimate is based on hydrographic and topographic surveys made in 1964 and 1966. The estimated first costs of the proposed plan of improvement are summarized in TABLE 1. Prices shown are those prevailing in the Martha's Vineyard area as of May 1969. The unit price of $1.90 per cubic yard is based on using a small hydraulic dredge in very close proximity to the disposal area and the dredge will be operating in well-protected waters having a tide range of 1 to 2 feet only. The U. S. Coast Guard has reported that no new aids to navigation will be required.

TABLE 1. PROJECT COST ESTIMATE

Katama Bay Dike - dredging and grading 570,000 cubic yards @ $1.90	$1,085,000
Beach grass - 58 acres @ $3,000	175,000
Sub-total dike	$1,260,000
Edgartown Anchorage - 10 acres, 6 feet deep - dredging 60,000 cubic yds. @$2.50	150,000
Total cost	$1,410,000
Contingencies	210,000
Total construction cost	$1,620,000
Engineering and Design	105,000
Supervision and Administration	130,000
Total Project Cost (Corps of Engineers)	$1,855,000 *

* Exclusive of $37,000 for pre-authorization studies.

51. As stated above, the 570,000 cubic yards of sand required to construct the barrier dike will be obtained from shoal areas in Katama Bay. Assuming that the areas to be dredged will have an average depth of 2 feet of water and will be dredged to a depth about one-half way between the 4 and 10 feet prescribed by U. S. Fish and Wildlife Service, i. e., 7 feet, the average cut would be 5 feet. This would result in dredging an area of about 70 acres, which is the amount of newly created shellfish habitat U. S. Fish and Wildlife Service claims would result from the dredging. Katama Bay contains far more than the quantity of materials needed for initial construction as well as for subsequent maintenance, which is estimated at 30,000 cubic yards per year (see paragraph 49). It is estimated that if Katama Bay were dredged to a depth of 10 feet, it could yield over 8 million cubic yards of materials, most of which are expected to be suitable for use on the barrier dike.

ESTIMATES OF BENEFITS

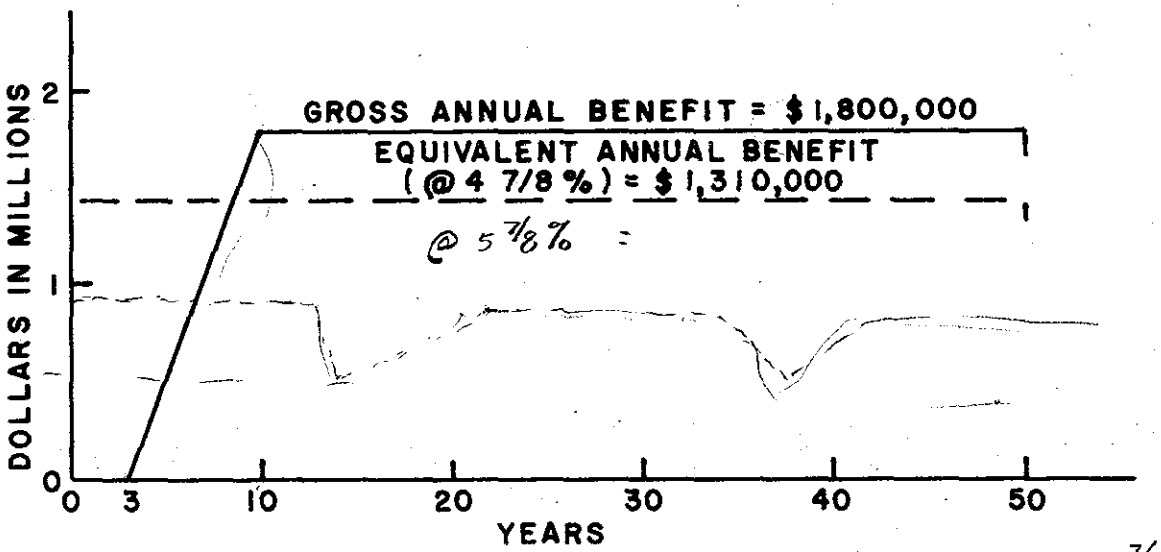
52. As a result of the proposed improvement, benefits will accrue to the shellfishing industry and to recreational boating interests. Existing commercial fishing boats are shallow draft, experience no serious navigational difficulties and will not benefit from the improvement. The benefits are determined in terms of net average annual values, using average annual equivalents where necessary. Evaluation of the benefits is as shown below.

a. Shellfishing. In its report in APPENDIX C, the U. S. Fish and Wildlife Service estimates annual harvests of 200 bushels of hard clams per acre and 50 bushels of bay scallops per acre from 570 acres of shellfish habitat improved by the project. Based on ex-vessel prices of $14 per bushel for clams and $8 per bushel for scallops, the gross annual benefit from shellfishing is $1,800,000. This benefit will not accrue immediately upon completion of the project. The first 3 years of project life will be required for the shellfish population to become established; no harvest will be produced. After 3 years, production will grow along a straight line to the maximum yield at 10 years of project life. This growth curve of the gross shellfishing benefit is shown in FIGURE 2. Using an interest rate of 4-7/8 percent, the equivalent annual gross benefit is $1,310,000 Taking 60 percent of the gross benefit as the cost of acquisition, the equivalent annual net benefit to shellfishing is $524,000 This benefit is based chiefly

200 × 570 × 14 = 1,596,000
50 × 570 × 8 = 228,000
1,824,000

200 × 570 × 21 = 2,394,000
50 × 570 × 12 = 342,000
2,736,000

GROWTH CURVE OF GROSS ANNUAL SHELLFISHING BENEFIT



$\Delta^{7/8}$ (5.1099)

$\frac{10(.7958612) - 3(0.9495686)}{7} = 0.7299866$

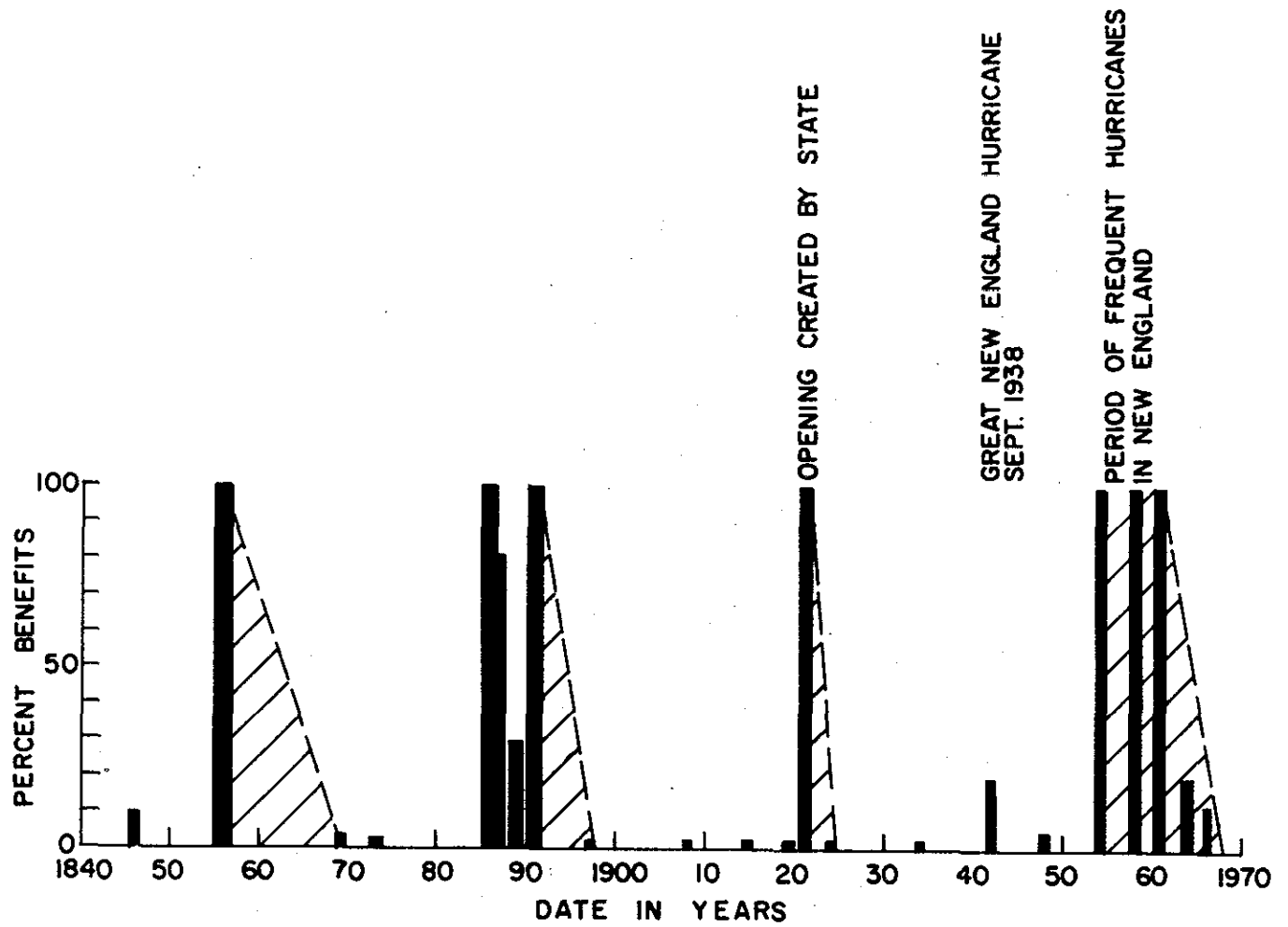
.729 .730 × 1.8 = 1,310,000
× 40% = 525,600 ✓

$5^{7/8}$ 4.8801631

$\frac{10(.7706788) - 3(0.9422083)}{7} = 0.6971661$

.697 × 1.8 = 1,254,900
× 40% = 501,959
= 500,000 –

R 9/69
Figure 2



PERCENT BENEFITS VS. DURATION OF BREACH OCCURRENCES
BARRIER BEACH AT KATAMA BAY
EDGARTOWN HARBOR, MASS.

Figure 3

on potential shellfish production. The estimated hard clam production of 114,000 bushels per year is over 5 times the 1907 harvest of 20,000 bushels, which is considered to be the maximum that could be sold at that time. The annual scallop production of 50 bushels per acre is moderate. Present demand for shellfish is much greater than the supply. The U. S. Fish and Wildlife Service states that the shellfish production potential, if Katama Bay is dredged, is excellent. The Service concludes that stabilization of the barrier beach will result in the re-establishment of a significant commercial shellfishery, contributing materially to year-round employment, thus benefiting the entire island. The benefits are considered general in nature. Information substantiating the prospective shellfish industry in Katama Bay is contained in the following paragraphs.

(1) Examination of the history of breaches in APPENDIX B and graphic presentation of this data in FIGURE 3, shows that there has been no long period of time during which Katama Bay could be considered in stable condition. The one period of time that appears at first glance to have been "stable" is that between 1924 and 1954. However, a study of APPENDIX B shows that the "Great New England Hurricane" struck on 21 September 1938, which resulted in at least one barrier breach. In 1942 there still remained two openings, each 2,000 feet long, separated by an island also 1,000 feet long. This constituted collectively, over one-fourth of the entire length of the barrier beach and under these conditions Katama Bay is in unstable condition. It took several more years for these openings to resolve themselves into one at the east end near Chappaquiddick, and create a so-called stable condition. Hence, the longest period of time between known breaches has been about 14 years, i.e., 1924 to 1938.

It is obvious that breaches occur with a high degree of uncertainty and unpredictability. Also wind-blown sand contributes in a substantial manner to unstable bottom conditions in the bay. Planting of dune grass and construction of sand fencing by the town has not proved successful in preventing erosion by waves. Summer conditions do result in a build-up of sand along the fences. However, frequent winter storms which result in waves attacking the beach directly appear to largely undo the summer buildup. With these factors in mind, local interests have been unwilling to invest the large amounts of funds necessary to dredge the bay to provide the depths necessary to establish a shellfish industry.

(2) Analysis of shellfish productivity and State law shows that each municipality in Massachusetts regulates its own shellfish beds with the State exercising only general control. The town limits the size of catch, the length of season and the areas to be worked as necessary to provide for replenishment of beds. A permit is required for each shellfish species. At present licenses are restricted to residents of Edgartown. A person must be a resident for one year to be eligible. The harvesting of scallops is restricted to the period 1 November to 1 April. Hard clams can be taken throughout the year. The present town limits are 4 bushels of hard clams (qualogs) and 4 bushels of scallops per person per day. Seasons and harvest rate are usually set in accordance with current shellfish populations. Dwindling shellfish populations can result in a reduction in harvest rate or a shortening of the open season or both. Also, an increase in the shellfish productinn could result in an increase in the daily harvest rate.

Edgartown Harbor is second only to New Bedford in the annual landings of shellfish for waterways in Massachusetts. The projection of 114,000 bushels of clams and 28,500 bushels of scallops for Katama Bay is based on demand, population and annual marketing. These increases can be provided by increasing the limits of the catches, issuing more licenses or opening more areas. Although it is noted that the total current shellfish landings for the State of Massachusetts are less than the projected landings for Katama Bay alone this fact alone indicates the great potential of the Katama fishery. Most of the water bodies along Massachusetts shores are polluted with shellfishing prohibited in all or large portions of each. Thus, the full potential of Massachusetts waterways is obviously far from being realized.

The annual harvests for hard clams in Massachusetts waters average 100 to 120 bushels per acre. Even 200 bushels per acre is not uncommon for isolated highly productive areas. Samples made of the bottom substrate in Katama Bay show the materials to be of the best composition for high productivity of the "little neck" hard clam fishery. Two hundred bushels per acre is a commonly experienced production generally, in many hard clam producing areas in Rhode Island, Connecticut and Long Island waters with habitat similar to that of Katama Bay. These areas annually produce 200-400 bushels per acre and even up to 500 bushels per acre. One state fisheries expert

estimates that it is possible that 500 bushels per acre can be obtained from certain areas of Katama Bay. Federal and state commercial fisheries experts agree that 200 bushels per acre could definitely be realized, especially under a management program developed and controlled by the town. The town has indicated its willingness and interest in such a program. Further, it has agreed to modify its shellfish regulations as necessary. As an example of the quantity of shellfish that a man can harvest in a highly productive area, local interests state that one man in a boat assisted in a moderate degree by his wife, son or daughter, can harvest, and has done so, his and his companion's limits (8 bushels total) in less than 4 hours.

(3) The unit prices of $14.00 per bushel for hard clams and $8.00 per bushel for scallops are considered reasonably indicative of present market conditions. As concerns clams, it is important to note that historically, the area has been primarily a "little neck" area. Dr. D. L. Belding in a report for the Massachusetts Commissioners for Fisheries and Game, titled "A Report Upon the Mollusk Fisheries of Massachusetts" (1909), stated that the finest "little neck" hard clam fishery in Massachusetts is found in Katama Bay. This size of hard clam brings the highest price of all hard clam groups. The Market News Service, Division of Economics of the U. S. Bureau of Commercial Fisheries for July 1966, showed that the wholesale price of "little necks" was $15.50 to $16.00 per bushel. In 1969, the same publication showed "little necks" selling for $19.00 to $20.00 per bushel at wholesale with some even higher. "Cherrystones", which are the intermediate sized hard clams, are selling for $13.00 to $14.50 per bushel, while the lowest value hard clam, the quahogs or "chowders" are selling for a much lower price. In Katama Bay the "little neck" will be harvested to the maximum potential; therefore, there will be a minimum number of fishermen to harvest the larger sized groups of hard clams.

(4) Consideration was given to the possible use of a mechanical "dredge" to harvest the shellfish. However, it was determined that Katama Bay is publicly-owned as a result of an old charter. As such, the only way a dredge could be used legally would be by town grant, but by law a grant cannot be issued if the area is termed naturally

productive, which is the case with Katama Bay. More important, it is unanimously agreed by Federal and State fisheries experts that the bay is too small for use of a dredge, i.e., it would not be feasible and justified for such a small area. Dredges can be used to advantage in large areas, such as Great South Bay, Long Island. Thus, the method of harvest in Katama Bay would be by hand labor.

The number of additional shell fishermen that will be required to harvest the projected shellfish catch is estimated at 40 full-time and 150 part-time men. In 1968 there were 126 persons licensed to take shellfish in Edgartown waters. A number of these were "family" fishermen who catch too much for personal use and resort to selling commercially. The full-time men work 5 days per week for a season of 21 weeks and they take 4 bushels of clams per day. In addition, a large number work part-time and are allowed the same daily limit. These shell fishermen fish a smaller area of productivity within the Town of Edgartown than will be available to them if the outer barrier is constructed. Increased acreage of premium shellfish habitat will encourage existing commercial fishermen to spend more time fishing. It will also encourage many more people who do not fish now to fish at least on the "family" level. It is reasonable to assume that some of the "family" shell fishermen will do some commercial fishing at least on a part-time basis.

Residents are engaged in occupations which cater to the recreational trade. As these occupations cease after September, these people seek other occupation. As other industry is very limited, the majority of persons engaged in summer recreational occupations are forced to subscribe to unemployment compensation. Should there be more opportunity for obtaining a daily limit of 4 or more bushels of clams at $14 per bushel, it is evident that more persons would become engaged in this industry. The number of unemployed persons in Dukes County in June 1969 was 80, of which about 50 were males. These figures do not include people not claiming unemployment insurance, which number is understood to be substantial.

There are at present, two "buyers" who buy the shellfish catch from islanders and sell on the mainland. Town officials have indicated that a third "buyer" would be available to buy and sell all the projected commercial shellfish. Town officials have also indicated that they will allow non-residents to fish in Edgartown waters if the shellfish production permits.

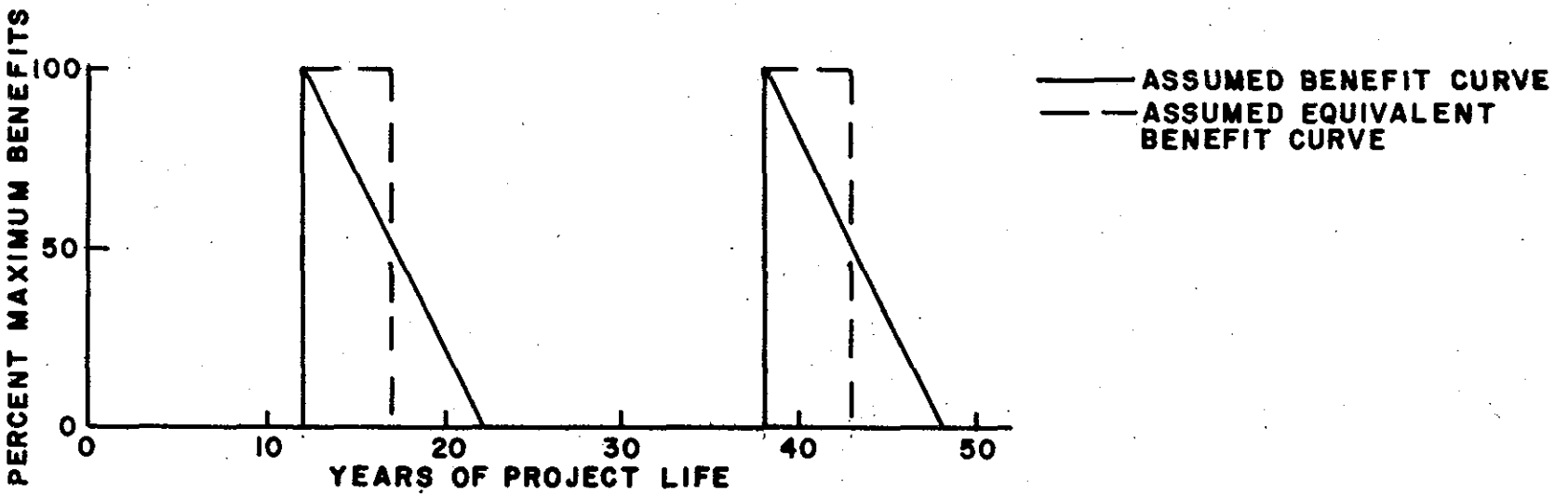
(5) It is estimated that the return to the prospective fishermen will be at least 40 percent of the gross ex-vessel value. This is based on comparative analyses made in the past for other fisheries as well as an independent analysis for this fishery. For example, a detailed analysis was made a number of years ago for the finfish industry of New Bedford. It was found that 40 percent of the ex-vessel value was the net value. In at least one other known fishery of New England, it was determined that an increase in the lobster fishery would be realized by the existing fleet and thus the net value would be 80 percent. The investment needed for a man to go into the shellfish industry is very nominal. He needs a skiff (16 feet long), a 2-3 horsepower outboard motor, a 35-foot long bull rake and 20-foot long tongs. There is no boat rental involved as the skiffs are merely beached at any convenient location. The total investment is about $500 with the attendant annual charges about $150. The annual median family income for all islanders is $4,745. However, many of the prospective fishermen are on the unemployed list, some of whom claim insurance and others not claiming. Thus, it is estimated that the total annual charges including fisherman's wages, involved in getting established in a new occupation is $4,000.

It is assumed that the full-time fisherman will work a net season of 200 days for clams. This results from deducting 104 weekend days and 60 days for adverse weather and personal reasons, from 365 days per year. The daily limit is now 4 bushels per day. Within recent time, when the resource permitted, the limit has been as high as 10 bushels per day. For the purpose of this report we have assumed an average catch of 5 bushels per clamming day. If the daily catch for clams were increased only 25 percent, i.e. to 5 bushels per day, the 40 full-time fishermen could harvest 40 x 5 x 200, or 40,000 bushels per year. Further, these same fishermen could land during the scallop season of 1 November to 1 April, 40 x 4 x 75 or 12,000 bushels per year, without increasing the daily limit. The 75 days results from deducing 40 weekend days and 35 bad weather days from the 150 day gross season. Assuming that the 150 part-time fishermen will work about one-third the total net season, or about 70 days, they could harvest 150 x 5 x 70, or 52,000 bushels of clams per year. Assume further that one-half of these part-time fishermen will work one-third the scallop season and thus harvest

75 x 4 x 25, or 7,500 bushels per year without raising the limit. In total, the full-time and part-time fishermen can be expected to harvest 92,500 bushels of clams per year and 19,500 bushels of scallops per year with but a moderate daily catch increase in clams. The remaining 21,500 bushels of clams and 9,000 bushels of scallops can be easily obtained by increased catches by existing fishermen. It is estimated that after the prospective improved shellfish industry is well under way, the number of full-time fishermen that will be involved will be 130. The gross value of the prospective additional fishery will be 114,000 x $14, or $1,596,000 for clams and 28,500 x $8, or $228,000 for scallops. This will result in gross income of $14,000/man. If $4,000 are the total charges involved, this represents less than 30 percent of the gross ex-vessel value. Therefore, the 40 percent used in this report is considered reasonable.

(6) Shellfish are currently being taken from Cape Poge Pond at Chappaquiddick Island and Sengekontacket Pond which lies northwesterly of Edgartown. However, Federal, state and local fisheries people agree that because of the long trips under exposed conditions that must be made by the small skiffs from Edgartown, the areas do not offer the harvesting potential of Katama Bay. The latter will be well protected with the barrier improvement. The cost to accomplish similar barrier improvements at Cape Poge Pond and Sengekontacket Pond is prohibitive.

b. Recreational boating. Provision of the high level barrier beach along the southerly shore of Katama Bay and the anchorage at Edgartown will both result in benefits to recreational boating. The barrier improvement will be discussed first. As noted previously, when the opening in thebarrier beach is located almost due south of Edgartown Harbor, the tidal currents at the latter location are strong and cause difficulties and hazards to anchored craft. The present opening in the barrier beach, having migrated easterly, is a narrow inlet parallel to the shore of Chappaquiddick Island. Tidal currents in Edgartown Harbor are presently nominal and boats experience few navigational difficulties. Thus, the tidal currents at Edgartown Harbor gradually diminish in intensity as the barrier breach moves toward Chappaquiddick Island. The barrier beach will prevent future breaches. Estimation of the resulting benefits to recreational boating is difficult because these benefits are dependent upon recurrences of hazardous tidal conditions which happen without the improvement.



EDGARTOWN HARBOR
KATAMA BAY BARRIER BEACH
ASSUMED BENEFIT CURVES FOR TWO BREACH OCCURRENCES

Figure 4

53. The procedure used in evaluating the benefits is as follows. Historical information is used to determine the frequency and duration of breach occurrences in the past. Assuming the past history indicates the future trend, an estimate is made of the number of years during the project life that tidal current problems will afflict Edgartown Harbor. Maximum benefits from the proposed improvement are estimated and reduced in proportion to the years of project life over which they could be realized.

54. Data from APPENDIX B is used to plot FIGURE 3. It is assumed that maximum benefits from the dune structure would have been realized in years when an opening was in the middle of the barrier beach. Similarly, no benefits would have been realized when the breach was hard against Chappaquiddick Island, as at present. Based on FIGURE 3, it is assumed that during a 50-year project life two breaches will occur without the project and that after each occurrence benefits will diminish along a straight line over a 10-year period. The assumed benefits are illustrated by FIGURE 4. It is further assumed that each 10-year period of declining benefits is equivalent to about 7.5 years of maximum benefits since adverse current conditions remain until the breach is nearly to Chappaquiddick Island. Therefore, maximum benefits are predicted for the equivalent of two 1-year periods or 30 percent of project life. No attempt is made to discount the benefits according to some exact time of occurrence in project life.

55. Recreational boating benefits are evaluated on the basis of net gain in for-hire return which boat owners would enjoy should improvements be made. Ideal return is expressed as a percentage of the average depreciated value of the boats comprising the existing and prospective fleets, varying both with sizes and types of boats. For use here, the gain represents the difference between harbor usage under conditions of maximum currents and usage with negligible currents. Usage in both cases is represented as a percentage of ideal return.

56. When maximum currents prevail, optimum use of available and prospective anchorage space in the inner harbor cannot be made due to the dissimilar swing characteristics in the boats. Unless the moorings are adequately spaced, there is danger of collision, with resultant boat damage. Overspacing of moorings requires part of the fleet, usually the larger boats, to anchor in the outer harbor where they are exposed to damage from northeasterly or easterly storms. Without the problem of strong currents, much more efficient use could be made of existing anchorage. Benefits to the existing local and equivalent transient fleets as a result of improved usage are calculated in TABLES 2 and 3. The net benefits accruing to the existing fleet under adverse tidal current conditions are $25,500. However, since the conditions of adverse currents occur about 30 percent of the time during the 50-year project life, only 30 percent of $25,500 is taken as the final benefit. These benefits are $7,600.

Similarly, the net benefits accruing to the existing equivalent transient fleet under adverse conditions are $8,300. With reduction, the benefits are $2,500.

57. Existing natural and proposed improvements in the area are expected to encourage and permit expansion of the existing local fleet by an additional 500 boats over the project life of 50 years. The proposed 10-acre anchorage is expected to be directly responsible for the addition of approximately 100 of the 500 boats. The number of 100 boats is based upon 10 boats per acre, which is reasonable in view of the small tidal range and the relative size of boats expected to use the anchorage. As a result of the anchorage and the proposed barrier beach, it is considered that benefits accruing to these 100 craft should be taken as 100 percent of the net benefits calculated in TABLE 4. The growth curve considered most representative of this additional fleet segment is the accelerated curve. Thus, benefits would result in the amount of $16,600.

58. There are several reasons to expect that the other 400 boats mentioned above will be added to the fleet. The Massachusetts State Access Board recently completed construction of a recreational boat launching ramp at the southwest corner of Katama Bay. Dredging in Katama Bay to obtain materials for the barrier beach will result in adequate boating depth. There is a substantial amount of naturally deep water area extending southerly from Chappaquiddick Point available for anchorage. The barrier beach will result in elimination of adverse tidal currents. It is anticipated that the 400 boats, all new, will be added to the existing fleet gradually along a straight line growth. It is considered that most of these craft will base in the area regardless of proposed Federal improvements. However, it is reasonable to assume that the addition of about one-third, or 130 boats, could be attributed directly to the proposed Federal improvements. The benefits expected to accrue to these craft are estimated to be $18,500 as derived in TABLE 5. Because these craft would be added to the fleet as a direct result of the proposed improvements, the full benefits are taken. The remaining 270 boats which would be added to the fleet regardless of improvement would realize some benefits similar to the existing 500-boat fleet. Based on direct proportion, the total benefits would be 270/500 x $25,500, or $13,800. The average annual equivalent benefit is $13,800 x 0.3282, or $4,500 Since the conditions of adverse currents occur about 30 percent of the time during the 50-year life, only 30 percent of $4,500 or $1,400 is taken as the final benefit.

TABLE 2. BENEFITS TO RECREATIONAL BOATING

Existing Local Fleet

HARBOR: Edgartown, Mass. Boating Season - 130 days

TYPE OF CRAFT	LENGTH (feet)	No. of BOATS	DEPRECIATED VALUE AVERAGE $	DEPRECIATED VALUE TOTAL $	PERCENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	VALUE $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
RECREATIONAL FLEET												
Outboards	15-20	260	1,200	312,000	14	95	100	0.70	2,184			
Inboards	15-20	20	2,500	50,000	12	90	100	1.2	600			
	21-30	20	4,800	96,000	11	90	100	1.1	1,056			
	31&up	5	19,800	99,000	10	90	100	1.0	990			
Stern Drive	15-20	25	1,900	47,500	12	95	100	0.60	285			
	21-25	20	3,600	72,000	11	90	100	1.1	792			
	26&up	5	8,200	41,000	10	90	100	1.0	410			
Sailboats	8-15	5	350	1,750	12	95	100	0.6	10			
	16-20	15	1,000	15,000	12	95	100	0.6	90			
	21-25	15	2,100	31,500	11	90	100	1.1	346	6	5	17
	26&up	5	3,700	18,500	10	90	100	1.0	185	16	12	22
Aux. Sail	15-20	5	1,800	9,000	9	90	100	0.9	81			
	21-30	10	4,900	49,000	8	85	100	1.2	588	6	5	29
	31-40	10	13,900	139,000	8	85	100	1.2	1,668	16	12	200
	41&up	5	27,000	135,000	7	85	100	1.05	1,418	20	15	213
Cruisers	15-20	5	2,500	12,500	9	90	100	0.9	113			
	21-30	25	5,000	125,000	9	90	100	0.9	1,125	12	9	101
	31-40	20	13,500	270,000	8	85	100	1.2	3,240	16	12	389
	41-50	15	34,600	519,000	8	85	100	1.2	6,228	24	18	1,121
	51&up	10	80,700	807,000	7	85	100	1.05	8,473	36	28	2,372
TOTALS		500		2,849,750					29,882			4,464

Total Benefits = $29,882 - $4,464 = $25,418

Say $25,500

TABLE 3. BENEFITS TO RECREATIONAL BOATING

Existing Transient Fleet

HARBOR: Edgartown, Mass.

TYPE OF CRAFT	LENGTH (feet)	No. OF BOATS	DEPRECIATED VALUE AVERAGE $	DEPRECIATED VALUE TOTAL $	PERCENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	VALUE $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
RECREATIONAL FLEET												
Outboards	15-20											
Inboards	15-20											
	21-30											
	31&up											
Stern Drive	15-20											
	21-25											
	26&up											
Cruisers	15-20											
	21-30	3	5,000	15,000	9	90	100	0.9	135			
	31-40	3	13,500	40,500	8	85	100	1.2	486			
	41-50	4	34,600	138,400	8	85	100	1.2	1,661			
	51&up	5	80,700	403,500	7	85	100	1.05	4,237			
Aux. Sail	15-20											
	21-30	2	4,900	9,800	8	85	100	1.2	118			
	31-40	5	13,900	69,500	8	85	100	1.2	834			
	41&up	3	27,000	81,000	7	85	100	1.05	851			
Sailboats	8-15											
	16-20											
	21-25											
	26&up											
TOTALS		25							8,322			
								Say	$8,300			

TABLE 4. BENEFITS TO RECREATIONAL BOATING

New Boats in Special Anchorage

HARBOR: Edgartown, Mass.

TYPE OF CRAFT	LENGTH (feet)	NO. OF BOATS	DEPRECIATED VALUE AVERAGE $	DEPRECIATED VALUE TOTAL $	PERCENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	PERCENT RETURN Gain	VALUE $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
RECREATIONAL FLEET												
Outboards	15-20	52	1,200	62,400	14	-	100	14	8,736			
Inboards	15-20	4	2,500	10,000	12	-	100	12	1,200			
	21-30	6	4,800	28,800	11	-	100	11	3,168			
Sterndrive	15-20	6	1,900	11,400	12	-	100	12	1,368			
	21-25	6	3,600	21,600	11	-	100	11	2,376			
Cruisers	15-20	2	2,500	5,000	9	-	100	9	450			
	21-30	5	5,000	25,000	9	-	100	9	2,250	12	9	202
	31-40	5	13,500	67,500	8	-	100	8	5,400	16	12	648
Aux. Sail	15-20	5	1,800	9,000	9	-	100	9	810			
Sailboats	8-15	4	350	1,400	12	-	100	12	168			
	16-20	5	1,000	5,000	12	-	100	12	600			
TOTALS		100		247,100					26,526			850

Net Benefits = $26,526 - $850 = $25,676

Annual Aver. Equivalent factor for accelerated growth

@ 4-7/8% = 0.645 (50 yrs) An. A.E. = $25,676 x 0.645 = $16,600

TABLE 5. BENEFITS TO RECREATIONAL BOATING

Growth of Local Fleet

HARBOR: Edgartown

TYPE OF CRAFT	LENGTH (feet)	NO. OF BOATS	DEPRECIATED VALUE AVERAGE $	DEPRECIATED VALUE TOTAL $	PERCENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	VALUE $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
RECREATIONAL FLEET												
Outboards	10-20	68	1,200	81,600	14	-	100	14	11,424			
Inboards	15-20	5	2,500	12,500	12	-	100	12	1,500			
	21-30	5	4,800	24,000	11	-	100	11	2,640			
	31&up	2	19,800	39,600	10	-	100	10	3,960			
Sterndrive	15-20	7	1,900	13,300	12	-	100	12	1,596			
	21-25	5	3,600	18,000	11	-	100	11	1,980			
	26&up	2	8,200	16,400	10	-	100	10	1,640			
Cruisers	15-20	2	2,500	5,000	9	-	100	9	450			
	21-30	7	5,000	35,000	9	-	100	9	3,150	12	9	284
	31-40	5	13,500	67,500	8	-	100	8	5,400	16	12	648
	41-50	4	34,600	138,400	8	-	100	8	11,072	24	18	1,993
	51&up	2	80,700	161,400	7	-	100	7	11,298	36	28	3,163
Aux. Sail	15-20	1	1,800	1,800	9	-	100	9	162			
	21-30	2	4,900	9,800	8	-	100	8	784	6	5	39
	31-40	2	13,900	27,800	8	-	100	8	2,224	16	12	267
	41&up	1	27,000	27,000	7	-	100	7	1,890	20	15	284
Sailboats	8-15	1	350	350	12	-	100	12	42			
	16-20	4	1,000	4,000	12	-	100	12	480			
	21-25	4	2,100	8,400	11	-	100	11	924	6	5	46
	26&up	1	3,700	3,700	10	-	100	10	370	16	12	44
TOTALS		130		695,550					62,986			6,768

Average Annual Equivalent Factor @ 4-7/8% = 0.3282

Straightline growth over 50 years.

Net Benefits = $62,986 - $6,768 = $56,218

AAE $56,218 x 0.3282 = $18,500

59. Because the expected increase in the existing local fleet will exhaust anchorage space, benefits from use of the waterway by attracted transient boats are expected to be negligible.

60. It is expected that most of the 100 new boats to be added to the fleet due to the proposed anchorage will be in the anchorage in 10 to 15 years. This typifies the accelerated growth curve. The remaining 400 craft will be added at a much slower rate along a straight-line growth curve. Many of these boats will probably be of the launch type at the outset with larger cruiser type being added as the improvements are established.

61. The number of fishing craft expected to result from the increased shellfishing will not cause undue congestion at Edgartown with the prospective recreational boat fleet. The fishing boats will be skiffs, about 50 - 100 on a full-time basis and 150 - 300 on a part-time basis, working at varying times during the year. The skiffs will be beached or hauled away from the harbor each day.

62. Damages have occurred to recreational craft as a result of adverse tidal currents. Extra spacing between moorings is necessary to allow boats to navigate safely to individual moorings. When the anchorage is nearly full, boats under way must occasionally sail broadside to the current. In this situation, these boats may either collide with moored boats or scrape their hulls on mooring lines, with damage to propellers. An estimate of the annual average damage under maximum current conditions considered that 30 percent of the local and transient fleets, or 160 boats, were involved. In addition, 30 percent of the 270 boats (80 boats) that would be added to the fleet regardless of improvement would also experience damages. As the boats are not under full power, unit monetary damage is usually small. Therefore, an average annual damage of $50 per boat was assigned to each boat involved. This results in a total average damage of (160 x $50) + (80 x $50)0.3282, or $9,300 annually. Improvement would not eliminate the total damage as some of it can be attributed to other causes such as poor seamanship, power failure, etc. Therefore, 25 percent of the annual damage was assigned to these causes and the remaining 75 percent, or $7,000, could be eliminated by improvement.

63. Construction of the barrier beach to prevent future breaching and the additional anchorage at Edgartown are expected to result in a

well protected, easily accessible and desirable harbor for vessels of both recreational and commercial nature which are transiting the nearby coast and find it necessary to use the harbor during storms. The benefits reasonably attendant to these offshore emergencies are estimated at $10,000.

64. The total benefits described in the foregoing paragraphs are summarized in TABLE 6, following:

TABLE 6. SUMMARY OF RECREATIONAL BOAT BENEFITS

Increased Recreational Boat Use:	
Benefits to existing local fleet	$ 7,600
Benefits to existing equivalent transient fleet	2,500
Benefits to new boats (100 in proposed new anchorage - accelerated growth)	16,600
Benefits to new boats (130 added as direct result of barrier beach - straight line growth)	18,500
Benefits to new boats (270 added regardless of improvements - benefit from reduced tidal currents)	1,400
Benefits from reduced damages	7,000
Protection against offshore emergencies	10,000
TOTAL BENEFITS	$63,600

ALLOCATION OF COSTS AMONG PURPOSES

65. Costs of the project should be allocated on a multi-purpose basis. In applying the separable cost-remaining benefits method, the first costs of construction are considered to be entirely joint-use costs. Separable costs cannot be identified since there are no feasible alternative projects to obtain the same benefits as raising the barrier beach. Construction of the 10-acre anchorage without construction of the Katama Bay barrier beach is not feasible as it constitutes an inadequate piecemeal improvement. The boats that would use the anchorage would realize a substantially reduced return on investment as the major recurring problem of excessive tidal currents which are related directly to the barrier breaches, would remain. Construction of the barrier by itself would not provide the required water area having adequate depth in close proximity to developed or developable shorefront for 50 year needs. This would be particularly true for the smaller craft. Therefore, the first costs and annual charges are allocated in proportion to benefits received, as shown in TABLE 7.

TABLE 7. BENEFITS

Type	General	Local	Total
Shellfishing	$524,000	$ -	$524,000
Increased recreational boating	31,800	31,800	63,600
TOTAL	$555,800	$31,800	$587,600
	94.6%	5.4%	100%

APPORTIONMENT OF COSTS AMONG INTERESTS

66. Based upon the foregoing distribution of general-local benefits, the Federal share of the construction cost would be 94.6 percent of $1,855,000, or $1,755,000 and the non-Federal share would be 5.4 percent, or $100,000.

ESTIMATED ANNUAL CHARGES

67. Annual charges for the navigation improvements have been computed on the basis of a 50-year project life with an interest rate of 4-7/8 percent. The quantity of materials required for restoration of the barrier beach and for re-opening the natural inlet at the east end (if found necessary) is estimated at 30,000 cubic yards per year. Maintenance costs for the anchorage basin are based on an average annual shoaling rate of 1,000 cubic yards. The annual charges are as follows:

ANNUAL CHARGES

Federal:	
Interest and amortization ($1,755,000 x 0.05372)	$ 94,300
Maintenance dredging - barrier beach (30,000 c.y. @ $2.00)	60,000
Maintenance dredging - anchorage (1,000 c.y. @ $3.00)	3,000
Total Federal	$157,300

(cont'd)

ANNUAL CHARGES (Cont'd)

Non-Federal:	
Interest and amortization ($100,000 x 0.05372	$ 5,400
Total Federal and Non-Federal	$162,700

COMPARISON OF BENEFITS AND COSTS

68. The estimated annual benefits of $587,600 (joint use) and the estimated annual charges of $162,700 result in a benefit-cost ratio of 3.6.

PROPOSED LOCAL COOPERATION

69. In addition to providing a cash contribution in the amount of $100,000, local interests should maintain and operate a suitable public landing at Edgartown Harbor to assure access for the boats to be accommodated by the improvement. It is expected that there is an existing, suitable pier facility that would be made available for this purpose. Local interests should also be required to hold and save the United States free from all damages which may result from the construction and subsequent maintenance of the project; provide without cost to the United States all lands, easements and rights-of-way required for construction and subsequent maintenance of the project and for aids to navigation; regulate the use, growth and free development of the harbor facilities with the understanding that they will be open to all on equal terms; and establish regulations prohibiting discharge of untreated sewage, garbage and other pollutants in the waters of the harbor by users thereof.

COORDINATION WITH OTHER AGENCIES

70. All Federal, State and local agencies having an interest in the Edgartown Harbor study were notified of the public hearing held in the town of Edgartown and all affected agencies were consulted during the study concerning possible benefits, adverse effects on their interests, and their general views. The U. S. Fish and Wildlife

Service reports that the proposed improvement would result in very substantial benefits to the shellfish industry in Katama Bay. The Fish and Wildlife report is contained in APPENDIX C. The Federal Water Pollution Control Administration report concludes that the proposed plan would result in minimal effects on water quality. The FWPCA report is contained in APPENDIX D. The U. S. Department of Health, Education and Welfare, whose report is also in APPENDIX D, agrees with the FWPCA that the proposed improvement would have little effect on water quality as long as the breach at the east end of the barrier beach is kept open. The State of Massachusetts, by letter dated 12 May 1969, has stated that it approves of the plan of improvement and is willing to participate in the improvement. The State's letter is in APPENDIX D. The Town of Edgartown has also indicated acceptance of the plan and a willingness and ability to participate financially as well as meet other items of local cooperation. The Town's report is in APPENDIX D.

DISCUSSION

71. The Division Engineer has undertaken this study to determine the need and justification for providing navigation improvements at Edgartown Harbor, Martha's Vineyard Island off the coast of Cape Cod, Massachusetts. The town of Edgartown has an economy oriented primarily toward summer recreational business and commercial fishing. An investigation of the history of Edgartown Harbor and of Katama Bay, which extends southerly of the harbor, reveals that the harbor has been subject, periodically, to excessive tidal currents caused by the breaching of the Katama Bay barrier beach by hurricanes and other severe storms. The currents create hazards and delays to recreational craft. Further, this recurring breaching has resulted in the sand siltation of the Katama Bay shellfish beds, once the source of a very important commercial industry. In addition to the problems caused by the breaching of the barrier beach, a further problem exists at Edgartown Harbor as a result of the need to provide anchorage space for the increasing recreational fleet. It is essential that a plan of improvement be provided which would prevent future breaches in the barrier bar, thus resulting in the elimination of hazardous and depressed recreational boating conditions, a reestablishment of the shellfish industry in Katama Bay, and in additional anchorage area.

72. It is estimated that the locally-based recreational boat fleet will double in the next 50 years. The major reasons for this estimation are as follows. A Corps report on Edgartown Harbor, prepared in 1938, stated that the number of locally-based recreational boats in the Edgartown Harbor fleet in 1936 was 275. The present number is 500. This represents an average annual increase of about 2.5 percent. Our present report estimates that the locally-based fleet will double in size over the project life of 50 years. This represents an average annual increase of about 2 percent. The national average is 6 percent per year. Ample water area will be available. In addition to naturally deep areas extending south into Katama Bay, the proposed plan would provide an additional 10 acres of area, 6 feet deep, at Chappaquiddick Point, which by itself will accommodate 100 craft. The State of Massachusetts recently completed construction of a boat-launching facility on the southwest shore of Katama Bay. The number of passengers carried via ferry from the mainland to the island increased from 23,810 in 1956 to 70,683 in 1966, nearly a 200% increase, or about 20% per year, which may serve as a measure of recreation growth on the island. The number of automobiles carried via ferry from the mainland to the island increased from 24,000 in 1956 to 71,000 in 1966, about a 200% increase, again a measure of island growth. The permanent population of Edgartown has remained essentially constant in the last decade; however, the summer population is between 600 and 700 percent greater than the permanent population. The increase of the summer population during the last decade is not known, but is considered to parallel the increases for passengers and automobiles indicated above. There are five harbors along the shores of Martha's Vineyard Island. Three have been improved by the Corps--Edgartown Harbor, Vineyard Haven Harbor, and Menemsha Creek (see inclosed map). The other two harbors have been improved by the State and/or local governments--Oak Bluffs Harbor and Tashmoo Pond. Oak Bluffs Harbor is filled to capacity and there is no room for expansion. Tashmoo Pond is shoal throughout, has poor land access, and its shores are owned largely by private interests. Menemsha Creek has a large developable water area, but the lack of shore access, the remote location from the ferry service, the negligible increase in summer population of the adjacent community, and the high cost of developing the water area make expansion of Menemsha Creek doubtful. The protected water areas of Vineyard Haven are filled to capacity. A recently authorized project for Lagoon Pond, which is a large body

of water contiguous to Vineyard Haven Harbor and with depths adequate for recreational craft, will allow for future expansion of the Vineyard Haven Harbor fleet. However, the expansion will be moderate and slow as the shore facilities and access are not fully adequate. Thus, the most feasible and logical harbor area for accommodating the prospective recreational craft, which will come not only from Edgartown but from other island communities and the mainland, is Edgartown Harbor.

CONCLUSIONS

73. The Division Engineer concludes that there is a recurring adverse tidal current problem at Edgartown Harbor resulting from periodic breaching by severe storm waves of the natural barrier beach extending along the southerly shore of Katama Bay, about 2-1/2 miles south of Edgartown Harbor. The natural barrier beach is insufficient in elevation and cross-section to prevent future breaching. The results of breaching are strong tidal currents which are hazardous to recreational craft at Edgartown Harbor, and the influx of sand from the ocean which is detrimental to the shellfishing industry in Katama Bay. He concludes that the beach should be strengthened to preclude future breaches. The Division Engineer also concludes that there is insufficient anchorage space at Edgartown Harbor in close proximity to existing facilities and thus considers more mooring area to be necessary.

RECOMMENDATIONS

74. The Division Engineer recommends improvement of Edgartown Harbor, Massachusetts to provide for (a) construction of an artificial high sand dune along Katama Beach from high ground on Martha's Vineyard toward Chappaquiddick Island, with retention of the existing breach at the easterly end, to an elevation of +16 (mlw) with cross-section generally as shown on the plates accompanying this report, and (b) an anchorage at Edgartown Harbor, 10 acres in area, 6 feet deep, would be the most economical and optimum plan to benefit the shellfishing industry and the recreational boating fleets of the area. The total project cost is estimated at $1,855,000. Annual maintenance is estimated at $63,000. This recommendation is made subject to the condition that local interests agree to provide the following items of local cooperation:

a. Provide a cash contribution of 5.4 percent toward the project cost, an amount currently estimated at $100,000;

b. Maintain and operate a public landing with berthing depths alongside commensurate to the anchorage depth;

c. Hold and save the United States free from all damages which may result from the construction and subsequent maintenance of the project;

d. Provide without cost to the United States all lands, easements and rights-of-way required for construction and subsequent maintenance of the project and aids to navigation;

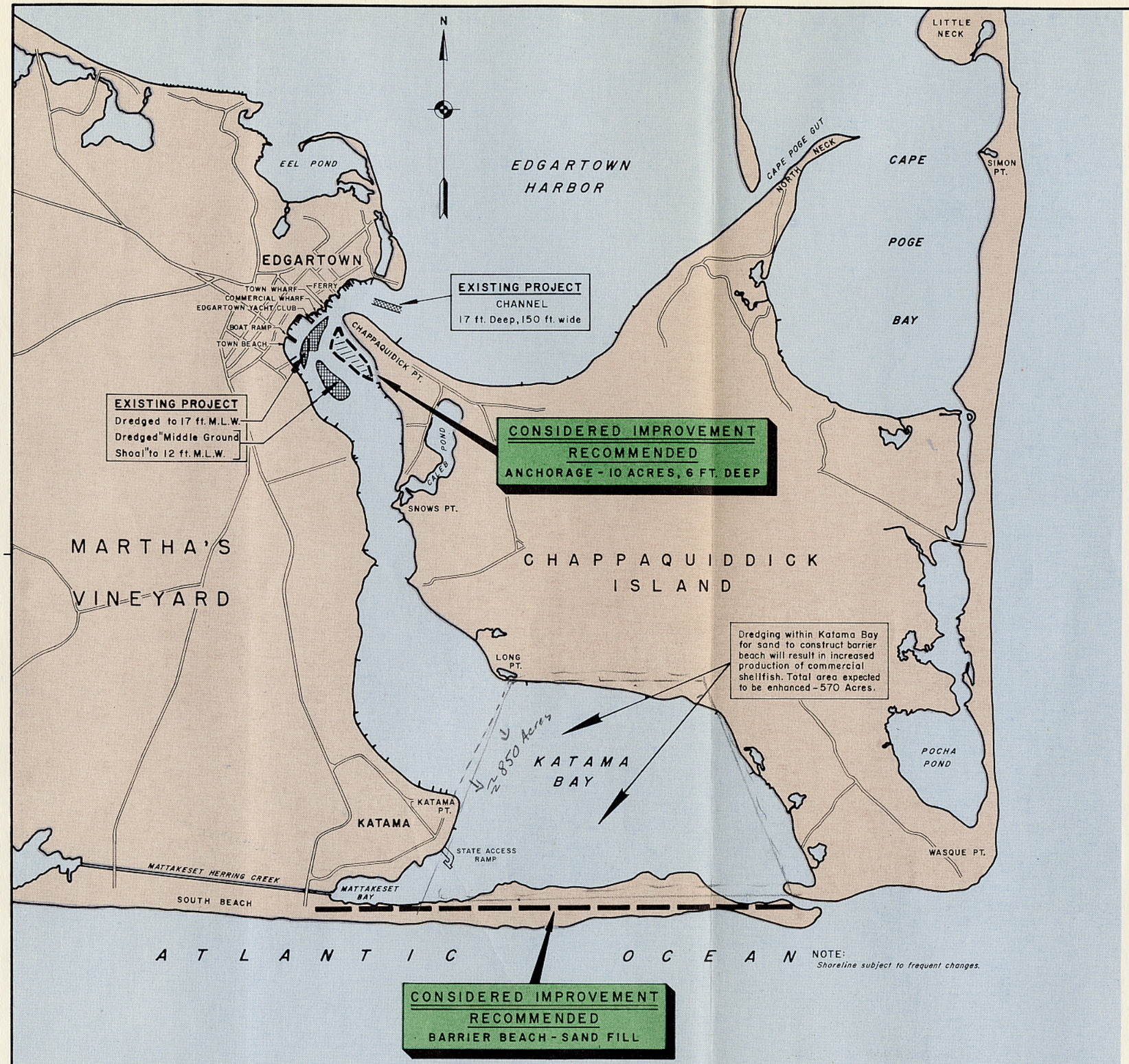
e. Regulate the use, growth and free development of the harbor facilities with the understanding that they will be open to all on equal terms; and

f. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control.

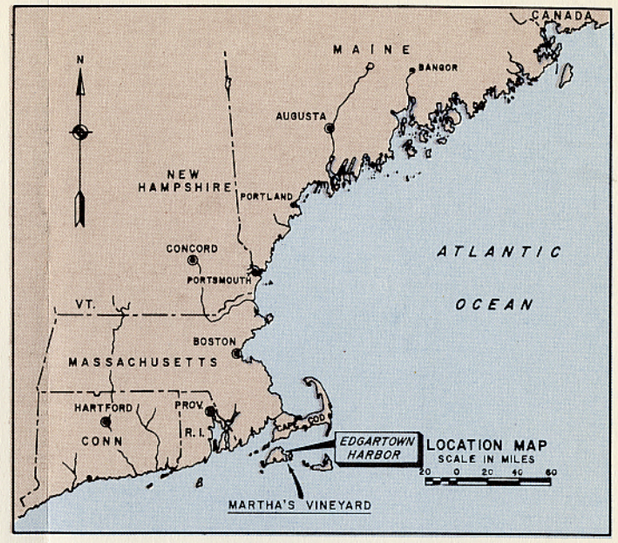
FRANK P. BANE
Colonel, Corps of Engineers
Division Engineer

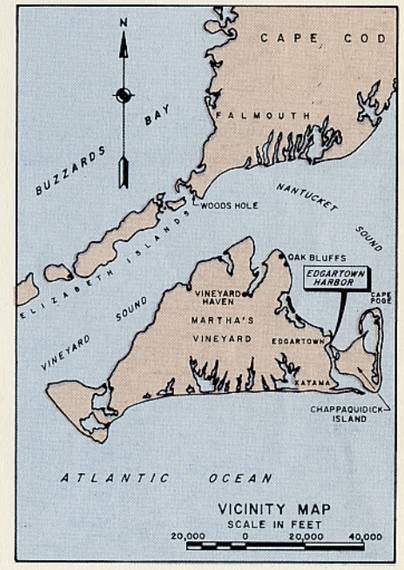
CORPS OF ENGINEERS

U. S. ARMY



NOTE:
Shoreline subject to frequent changes.





DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
ALD	ALD	###

SUBMITTED: Emerson H. Tuttle, PROJECT ENGINEER
Oscar E. Anson, CHIEF, COASTAL DEVEL. BRCH.
APPROVAL RECOMMENDED: CHIEF, PLANNING BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION
DATE: APRIL 1969

EDGARTOWN HARBOR
MARTHA'S VINEYARD, MASS.
GENERAL PLAN

SCALE IN FEET
1000 0 1000 2000 3000

SCALE AS SHOWN

TO ACCOMPANY SURVEY REPORT DATED: 23 MAY 1969

DRAWING NUMBER
En. 138

SHEET 1 OF 5

PLATE NO. 1

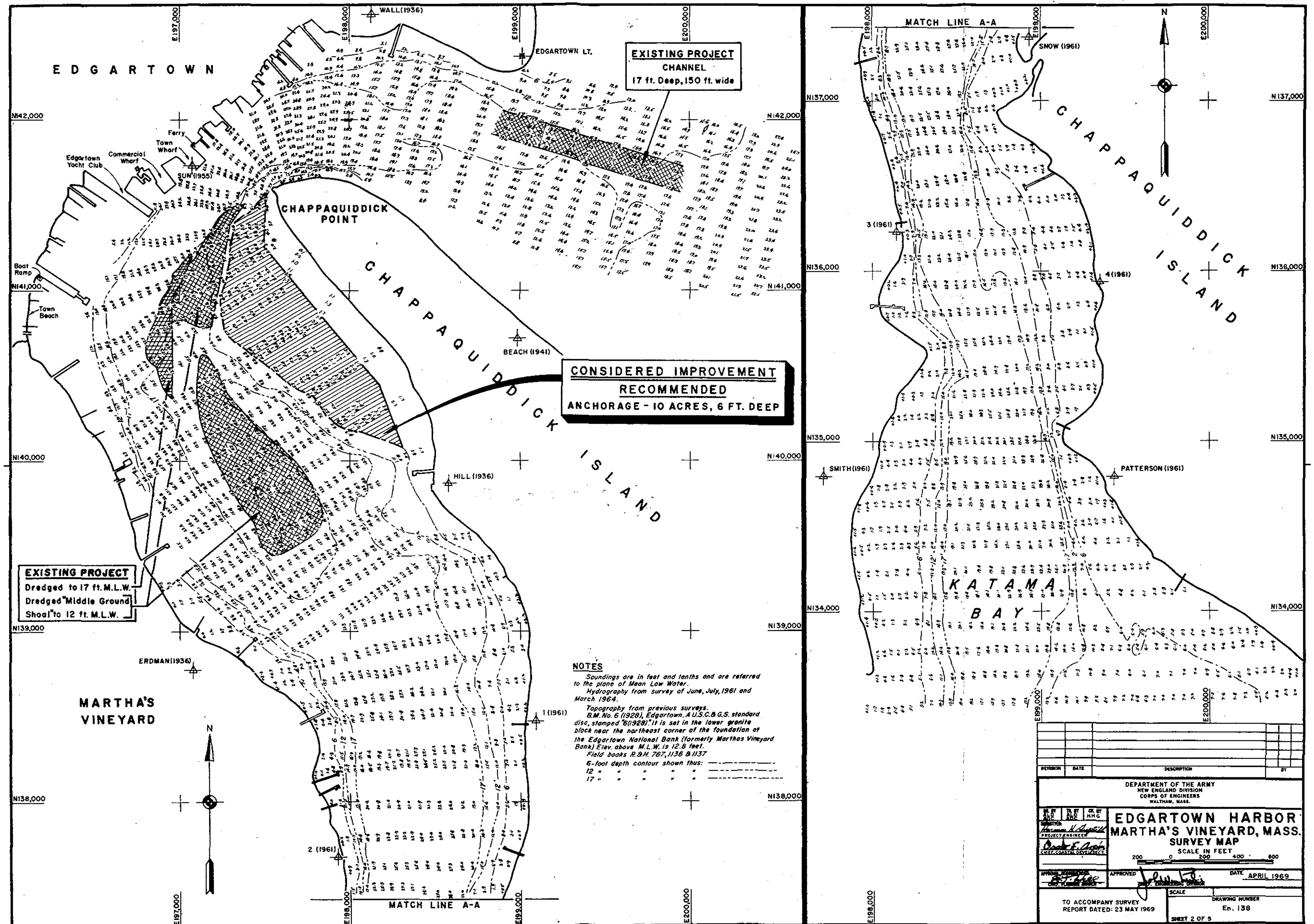
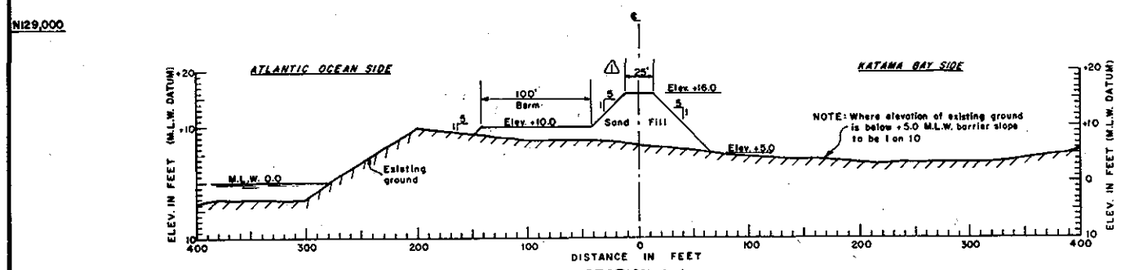

EDGARTOWN
WALL (1936)
EDGARTOWN LT.
EXISTING PROJECT
CHANNEL
17 ft. Deep, 150 ft. wide
Ferry
Town Wharf
Commercial Wharf
Edgartown Yacht Club
SUN (1955)
Boat Ramp
Town Beach
CHAPPAQUIDDICK POINT
CHAPPAQUIDDICK ISLAND
BEACH (1941)
CONSIDERED IMPROVEMENT
RECOMMENDED
ANCHORAGE - 10 ACRES, 6 FT. DEEP
HILL (1936)
EXISTING PROJECT
Dredged to 17 ft. M.L.W.
Dredged "Middle Ground" Shoal to 12 ft. M.L.W.
ERDMAN (1936)
MARTHA'S VINEYARD
1 (1961)
2 (1961)
N
MATCH LINE A-A
N142,000
N141,000
N140,000
N139,000
N138,000
N137,000
N136,000
N135,000
N134,000
E197,000
E198,000
E199,000
E200,000
NOTES
Soundings are in feet and tenths and are referred to the plane of Mean Low Water.
Hydrography from survey of June, July, 1961 and March 1964.
Topography from previous surveys.
B.M. No. 6 (1928), Edgartown. A U.S.C.&G.S. standard disc, stamped "6(1928)." It is set in the lower granite block near the northeast corner of the foundation of the Edgartown National Bank (formerly Marthas Vineyard Bank) Elev. above M.L.W. is 12.8 feet.
Field books R.&H. 767, 1136 & 1137
6-foot depth contour shown thus:
12 " " " " "
17 " " " " "
SNOW (1961)
3 (1961)
4 (1961)
SMITH (1961)
PATTERSON (1961)
CHAPPAQUIDDICK ISLAND
KATAMA BAY
REVISION
DATE
DESCRIPTION
BY
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
HHG
PROJECT ENGINEER
CHIEF, COASTAL DEVEL. SECT.
EDGARTOWN HARBOR
MARTHA'S VINEYARD, MASS.
SURVEY MAP
SCALE IN FEET
200 0 200 400 600
APPROVED
DATE APRIL 1969
SCALE
TO ACCOMPANY SURVEY
REPORT DATED: 23 MAY 1969
DRAWING NUMBER
En. 138
SHEET 2 OF 5

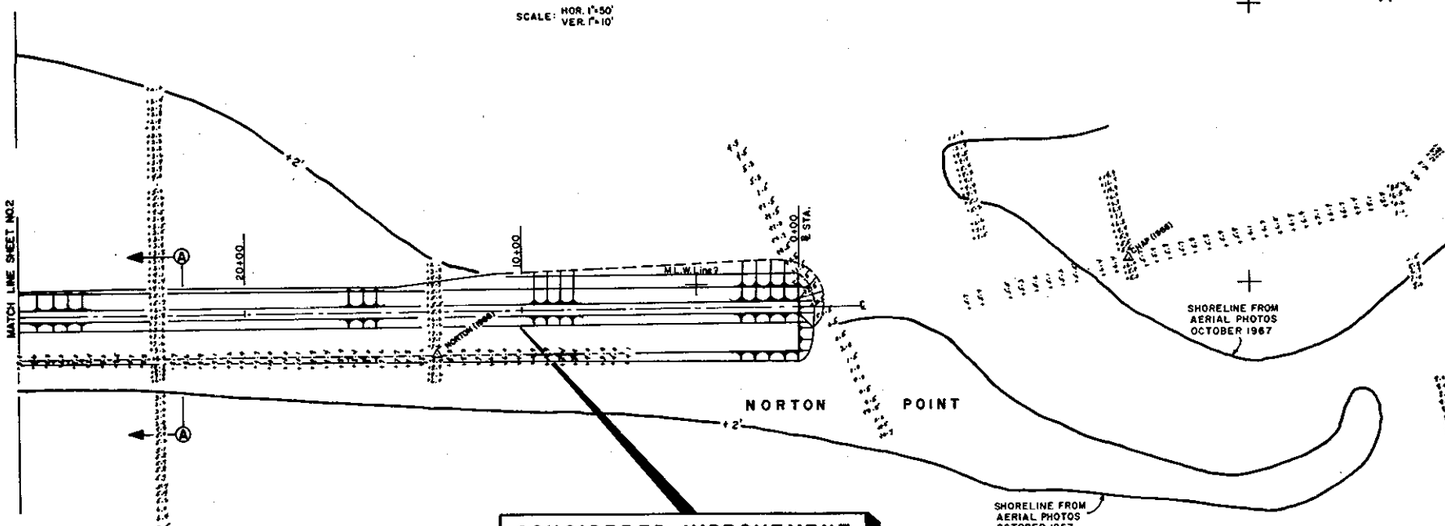
PLATE NO. 2

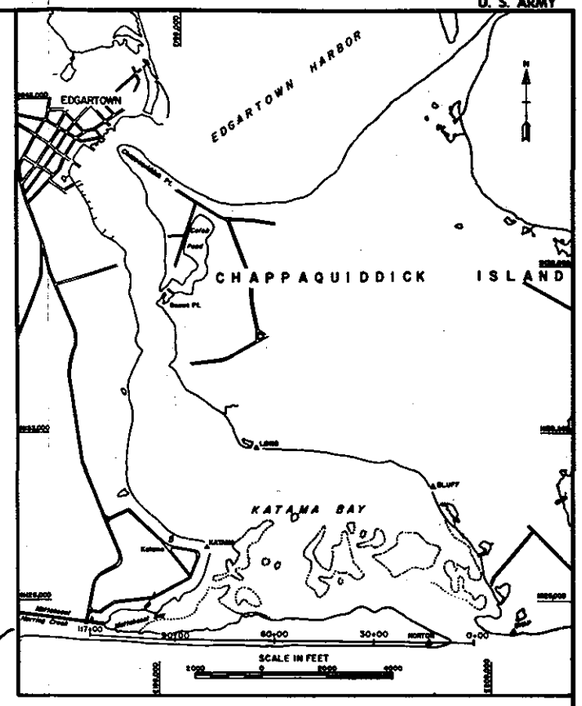
CORPS OF ENGINEERS

U. S. ARMY



SECTION A-A
STA. 22+30
SCALE: HOR. 1"=50'
VER. 1"=10'





NOTES

Soundings and elevations are in feet and tenths and are referred to the plane of the Mean Low Water.

Hydrography from survey of 28 & 29 Sept. & 18 Oct. 1966 by J. Barry & H. Fishlock.

B.M. 6 (1928) is a C.&G.S. standard disk stamped 6 (1928). It is set in the lower granite block near the N.E. corner of the foundation of the Edgartown National Bank (formerly Marthas Vineyard Bank). El. above M.L.W. 12.8'

Coordinates are on the Lambert system for the State of Massachusetts. (Islands)

Field books R&H 1915, 1916 & 2596.

REVISION	DATE	DESCRIPTION	BY
1	10-1-69	Top distance of sand fill revised. (SECT. A-A)	ADC

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY WAR | TR. BY T.S.C. | CK. BY N.M.G

SUBMITTED
PROJECT ENGINEER

CHIEF, COASTAL DEVEL. SECT.

APPROVAL RECOMMENDED
CHIEF, PLANNING BRANCH

APPROVED
CHIEF, ENGINEERING DIVISION

EDGARTOWN HARBOR, MASS.
KATAMA BAY BARRIER BEACH
PLAN-SECTION

SCALE IN FEET
200 0 200 400 600

DATE APRIL 1969

SCALE

DRAWING NUMBER
En. 138

TO ACCOMPANY SURVEY REPORT DATED: 23 MAY 1969

SHEET 3 OF 5

PLATE NO. 3

CORPS OF ENGINEERS

U. S. ARMY

ATLANTIC OCEAN

KATAMA BAY

MATTAKESET BAY

MATCH LINE A-A

MATCH LINE SHEET NO.1

KATAMA SHORES RD. STA. 17+50

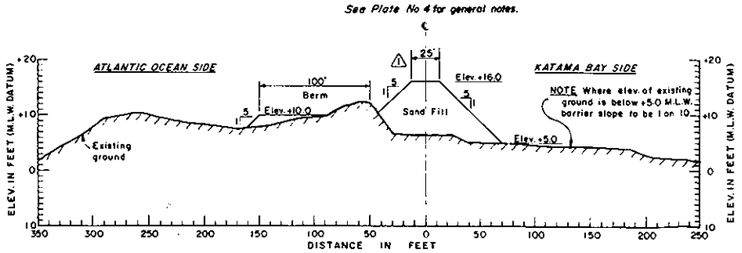
N127,000 N126,000 N125,000 N129,000 N128,000

E196,000 E197,000 E198,000 E199,000 E200,000 E201,000 E202,000 E203,000 E204,000 E205,000

PLAN VIEW

CONSIDERED IMPROVEMENT
RECOMMENDED
BARRIER BEACH-SAND FILL

NOTE
See Plate No 4 for general notes.



SECTION B-B
STA. 34+10
SCALE: HOR. 1"=50'
VER. 1"=10'

REVISION	DATE	DESCRIPTION	BY
1	10-1-69	Top distance of sand fill revised (SECT. B-B)	ADC

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY H.H.G.	TR. BY A.D.C.	CK. BY M.A.J.

SUBMITTED
PROJECT ENGINEER
CHIEF COASTAL DESIGN SECT.

APPROVAL RECOMMENDED
CHIEF, PLANNING BRANCH

APPROVED
CHIEF, ENGINEERING DIVISION

DATE APRIL 1969

EDGARTOWN HARBOR, MASS.
KATAMA BAY BARRIER BEACH
PLAN-SECTION

SCALE IN FEET
200 0 200 400 600

TO ACCOMPANY SURVEY REPORT DATED: 23 MAY 1969

SCALE

DRAWING NUMBER
En. 138

SHEET 4 OF 5

PLATE NO. 4

CORPS OF ENGINEERS

U. S. ARMY

E.190,000

70° 32'

E.200,000

70° 29'

E.210,000

41° 22'

N 130,000

M A R T H A' S V I N E Y A R D

△KATAMA NO. TOWER

△WASQUE PT. HOUSE CUPOLA, 1932

KATAMA BAY

KATAMA (1949) △

△HARRING POND

A T L A N T I C O C E A N

41° 20'

N 120,000

E.190,000

70° 32'

E.200,000

70° 29'

E.210,000

41° 20'

N 120,000

N

NOTE:
All shorelines are from surveys of the U.S.C.&G.S. Polyconic Projection, Datum N.A. 1927 except 1967 line, which was taken from aerial photos by Corps of Engineers.

LEGEND

HIGH WATER SHORELINE

1967	———	Corps of Engrs.
1948-49	—•—o—•—	U.S.C.&G.S.
1897	•—•—•—•	"
1886	·····	"
1846	– – – –	"

NO.	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

CHIEF, ENGINEERING DIVISION

EDGARTOWN HARBOR
MARTHA'S VINEYARD, MASS.
SHORELINE CHANGES 1846-1967

SCALE IN FEET

1000 0 1000 2000 3000

APPROVED

DATE APRIL 1969

CHIEF, ENGINEERING DIVISION

TO ACCOMPANY SURVEY REPORT DATED: 23 MAY 1969

SCALE

DRAWING NUMBER En. 138

SHEET 5 OF 5

PLATE NO. 5

APPENDIX A

DESIGN CRITERIA FOR PROPOSED PLAN OF IMPROVEMENT

APPENDIX A

DESIGN CRITERIA FOR PROPOSED PLAN OF IMPROVEMENT

1. General. The proposed plan of improvement is designed to prevent breaching of the middle and westerly portions of the Katama Bay barrier beach in the most severe storm of record in the vicinity, Hurricane Carol of 31 August 1954. Under this plan, a dune structure would be built from high ground on Martha's Vineyard to the existing opening next to Chappaquiddick Island. The opening would be left at its present location to help prevent pollution and shoaling problems in Edgartown Harbor.

A dune profile is adopted similar to one developed for protection of the south shore of Long Island. The profile consists of a crest section 25 feet wide at 16.0 feet above mean low water, fronted by a 100-foot protective berm at 10.0 feet above mean low water. Side slopes are 1:5. In view of the high shoreline recession rate, the structure will be placed at some distance behind the existing shoreline (to be determined during preconstruction planning) to be reasonably safe throughout project life. Criteria on which the design is based are presented in the following paragraphs.

2. Hurricane Carol of 31 August 1954. The highest still water levels known to have occurred in the vicinity of Martha's Vineyard were caused by Hurricane Carol of 31 August 1954. No recorded information on the maximum level in the open ocean off Katama Bay is available. However, high watermark data at nearby locations was compiled in connection with other studies. On Martha's Vineyard, data is available for the populated areas of Edgartown, Oak Bluffs, Vineyard Haven, and Menemsha. For the first three, average high water was 7.6 feet above mean sea level. However, at Menemsha the water elevation was 9.2 feet above mean sea level. This latter figure is in agreement with data taken along the south shore of Cape Cod. Examination of Carol's tracks shows that Edgartown, Oak Bluffs, and Vineyard Haven were all in the lee of the storm winds and surge. It would seem reasonable that the water level at these locations was lower than that along the south shores of Martha's Vineyard and Cape Cod. Therefore, a still water level of 9.2 feet above mean sea level is adopted as being typical of Hurricane Carol along the south shore of Martha's Vineyard.

An estimate of the storm tide generated by Carol can be made using techniques described below. The water elevation is treated as a superposition of three components: wind set-up, barometric rise, and astronomical tide.

The wind set-up is given by:

$$n_m = \left[K \frac{T}{\overline{C}_1} \left(\frac{h_1}{h_o} \right)^{1/4} \right] W_m^{\,2} S$$

where n_m = Wind set-up

K = dimensionless coefficient equal to 3.3×10^6 for T in sec. and W_m in ft./sec., or .01746 for T in hours and W_m in miles/hr.

$T = \frac{L}{\overline{C}}$

L = distance from shore to the edge of the continental shelf

$\overline{C} = 1/2 (C_o + C_1)$

$C_o = \sqrt{gh_o}$

$C_1 = \sqrt{gh_1}$

h_1 = effective depth at the edge of the continental shelf

h_o = effective depth at shore

W_m = wind speed

S = response factor related to the fetch length F, the forward storm speed V, L, and $\overline{C}$

Using Coast and Geodetic Survey Chart 1000, the following values were obtained:

$T = 1.87$ hours

$L = 82$ nautical miles

$\overline{C} = 1/2(C_o + C_1) = 50.5$ mph $= 43.9$ kts

$C_o = \sqrt{gh_o} = 25.1$ mph

$C_1 = \sqrt{gh_1} = 75.9$ mph

$h_1 = 384$ feet

$h_o = 42$ feet

$$n_m = \left[\frac{.01746 \times 1.87}{75.9}\left(\frac{384}{42}\right)^{1/4}\right] W_m^{\,2} S$$

$$= .000749\ W_m^{\,2} S$$

In Table 3 of Technical Memorandum No. 83, Reid gives the following data for Carol:

$F = 87$ nautical miles

$W_m = 95$ mph

$V = 32$ mph

With this data and Figure 13 of the same publication, S is found to be 1.08. A final calculation yields the wind set-up:

$$n_m = .000749 \times (95)^2 \times 1.08$$

$n_m = 7.3$ ft.

The barometric rise is estimated using equation 1-62 of Technical Report No. 4 of the Coastal Engineering Research Center, "Shore Protection Planning and Design."

$$S_1 = 1.14 \Delta P_o \left[1 - e^{-\frac{R}{r}} \right]$$

S_1 = barometric rise in feet of water

$= P_n - P_o$

P_n = normal atmospheric pressure in inches of mercury

P_o = central pressure in inches of mercury

R = radius of maximum winds measured from the center

r = radius to point of interest measured from the center

The parameters above are evaluated using data from two publications: "Hurricane Survey of Narragansett Bay Area," submitted 11 January 1965 by the U. S. Army Corps of Engineers, New England Division; and Report No. 5 of the National Hurricane Research Project, "Survey of Meteorological Factors Pertinent to Reduction of Loss of Life and Property in Hurricane Situations," issued by the U. S. Weather Bureau in March 1957. From a plate preceding page 17 of the first,

r = 70 miles (approximately)

and from Table 3-1 of the latter,

P_o = 28.35 inches of mercury

R = 22 nautical miles = 25 statute miles.

Neither source gives P_n for Carol; therefore, a normal atmospheric pressure of 29.90 inches is assumed, yielding

P_o = 29.90 -28.35 = 1.55 inches of mercury.

Substituting these values into the relationship for barometric rise:

$$S_1 = 1.14 \times 1.55 \times (1 - e^{-\frac{25}{70}})$$

$$= 0.5 \text{ feet}$$

The wind set-up and barometric rise must be added to the astronomical tide to arrive at the still water level. Information given in Table B-5 of the Narragansett Bay Report indicates that Carol's storm surge attacked Menemsha at a high tide of 1.5 feet above sea level. The components of the storm tide are summed in TABLE A-1, below:

TABLE A-1 - STORM TIDE AT MENEMSHA (Hurricane Carol)

Item	Feet
Wind set-up	7.3
Barometric rise	0.5
Astronomical tide	1.5
Total surge exclusive of runup	9.3

This result agrees well with the 9.2-foot elevation indicated by high watermark information.

3. Design Storm Tide. Plates B-10 and B-11 of the report, "Hurricane Survey of Narragansett Bay Area," show that the tidal flood elevations caused by Hurricane Carol have less than a 2 percent chance of occurring in a given year, based on historical data. The corresponding frequency of occurrence is more than 50 years, which is usually taken as the economic life of a project. Therefore, Hurricane Carol is selected as the design storm.

From above, the wind set-up in Hurricane Carol was calculated to be 7.3 feet in the Martha's Vineyard area. At the radius of maximum wind, where wind set-up is greatest, the barometric pressure rise will be

$$S_1 = 1.14\ P_o(1 - e^{-\frac{R}{r}})$$

$$= 1.14 \times 1.55 \times 0.63$$

$$= 1.1 \text{ feet.}$$

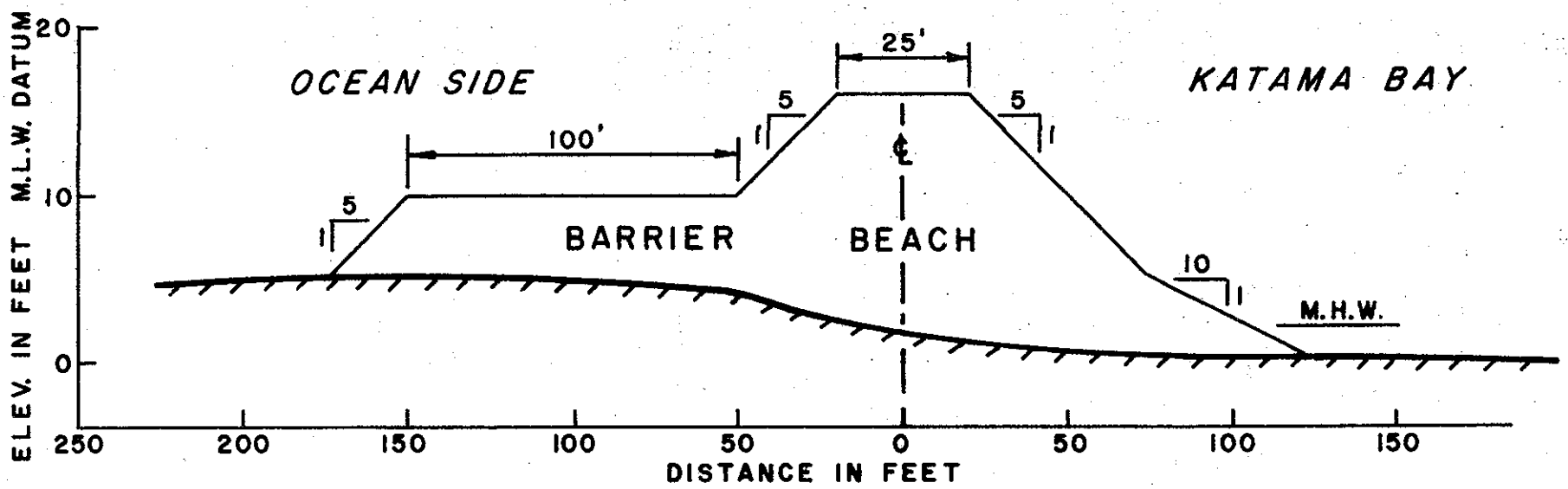
To obtain the storm tide elevation, the wind set-up and barometric rise must be added to the astronomical tide, which is very complex at the east end of Martha's Vineyard. Tidal information is published by the U. S. Coast & Geodetic Survey for three locations in the vicinity of Katama Bay: (1) Edgartown; (2) off Job's Neck Pond, about 4 miles west of Katama Bay; and (3) off Wasque Point, less than 1 mile east of Katama Bay. The mean tide ranges are: Edgartown, 1.9 feet; Wasque Point, 1.1 feet; and off Job's Neck Pond, 2.7 feet. A mean astronomical tide range of 2.0 feet will be assumed along the barrier beach. The design storm tide is summarized in TABLE A-2.

TABLE A-2. DESIGN STORM TIDE

Item	Feet
Wind set-up	7.3
Barometric rise	1.1
Astronomical tide	2.0
Total rise above mean low water (exclusive of runup)	10.4

4. Design of the Dune Structure. FIGURE A-1 shows a profile of the dune structure as designed for the Katama Bay barrier beach. The general configuration is taken from a profile developed for the south shore of Long Island, New York. Crest elevation is selected to prevent overtopping, and the 100-foot berm is intended to reinforce the toe of the crest section against scour and subsequent collapse. Side slopes of 1:5 are chosen to provide a compact profile, yet compare favorably with field observations of existing dune slopes at the site.

Shoreline change maps show that the south shore of Martha's Vineyard is receding about 8 feet per year. To build the dune structure on the existing shoreline would require extensive shore stabilization measures such as beach nourishment or a groin system. Therefore, it is recommended that the structure be located at some alignment between 400 feet behind the present shoreline (50-year project life) and its present alignment. First costs of construction will be somewhat higher, but significant savings will be made in annual maintenance. Near Martha's Vineyard, the rear toe of the structure will enter Katama Bay. Here, the back slope is flattened to 1:10 below elevation 5 feet above mean low water to counteract possible erosion due to waves.



EDGARTOWN HARBOR
TYPICAL PROFILE-REAR TOE ENTERING KATAMA BAY

R 9/69

Figure A-1

The first step in designing the dune profile is selection of a berm elevation. Tests made by the Beach Erosion Board for the Long Island Study indicated that elevation of the berm should approximate the storm tide elevation in order to reduce wave runup and scour at the toe of the crest section. Therefore, berm elevation is set at 10.0 feet above mean low water.

Overtopping of the crest by wave runup should be prevented in order to avoid erosion and possible breaching of the structure. To determine runup, the composite slope method outlined by Saville in the Proceedings of the Sixth Conference on Coastal Engineering is used. A typical composite slope is shown on FIGURE A-2 where several profiles obtained from a 1966 hydrographic survey are plotted. In order to represent conditions at the end of project life, the dune structure is placed directly on the 1966 shoreline. The foreshore slope is carried up to a 100-foot berm at 10 feet above mean low water which fronts the 1:5 slope of the crest section.

To apply the composite slope method, the actual composite slope is replaced by a hypothetical simple slope between the breaking depth and an estimated value of wave runup. This slope is then used to enter correlations of relative runup $\frac{R}{H_o'}$, the slope, and deepwater wave steepness $\frac{H_o'}{T}$, where

R = vertical height above still water level to which water will rise on the face of the structure.

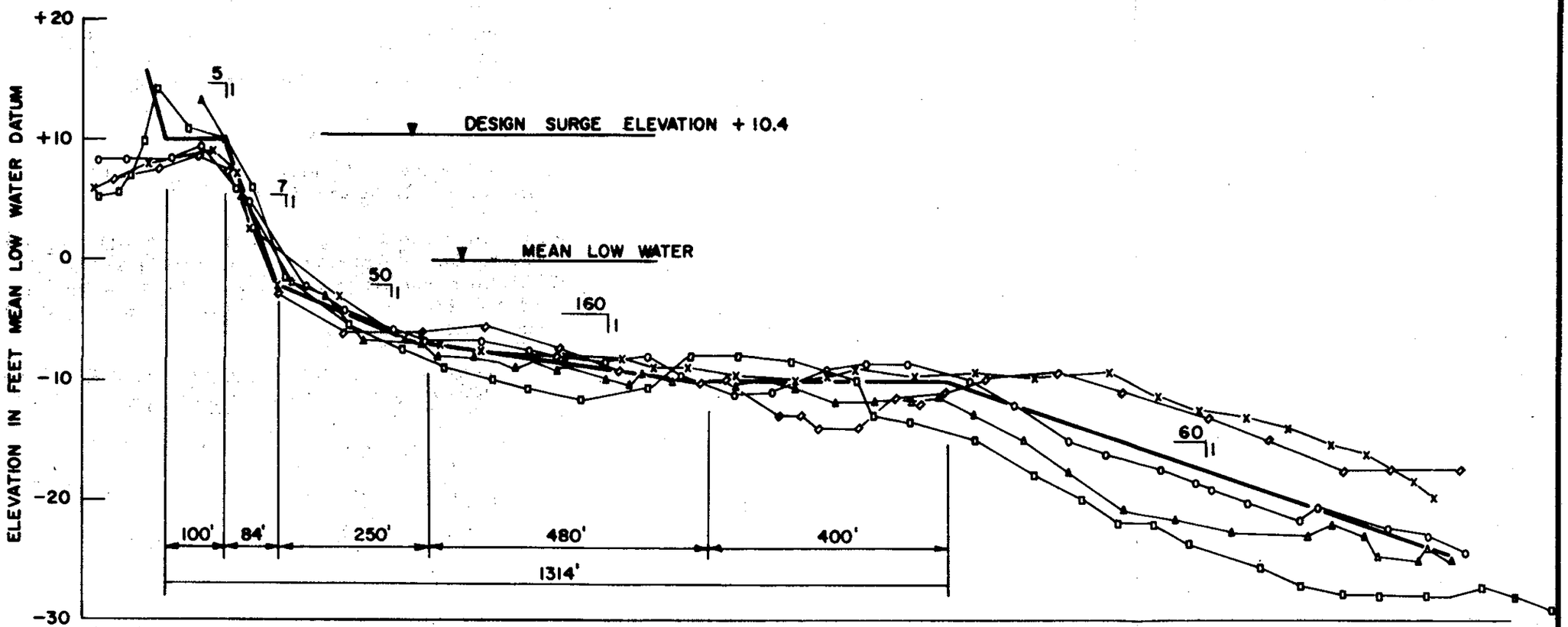
H_o' = deepwater wave height corrected for refraction.

T = wave period.

A new value of runup is obtained and compared with the estimated value. If necessary, the process is repeated until agreement is reached. The deepwater wave height may be obtained from the breaking height and depth conditions given by solitary wave theory:

$$H_b = 0.78 d_b$$

$$H_o' = 1.5 d_b (H_o'/T^2)^{1/3}$$



OFFSHORE PROFILES FROM HYDROGRAPHIC SURVEY OF SEPTEMBER-OCTOBER 1966
TYPICAL COMPOSITE SLOPE

Figure A-2

An approximation of the wave period T for hurricane-generated waves is given by equation 1-46 of Technical Report No. 4 of the Coastal Engineering Research Center:

$$T = 2.13\sqrt{H_o}$$

or $$H_o' = .22 \qquad (H_o = H_o')$$

In making this approximation, refraction effects have been ignored, a reasonable assumption for the south shore of Martha's Vineyard. Substituting into the breaking depth expression:

$$H_o' = 0.91 d_b$$

In general, values of H_o' greater than H_b are not used for design purpose; a value of $H_o' = H_b$ is used instead.

Runup is evaluated at a series of breaking depths d_b to find the maximum for determination of the crest elevation. Preliminary calculations indicate that this maximum will occur for a wave breaking at the toe of the 1:7 foreshore slope. TABLE A-3 summarizes the runup calculation at this point.

TABLE A-3. CALCULATION OF RUNUP FOR WAVE BREAKING AT TOE OF 1:6 FORESHORE SLOPE

$d_b = 10.4 + 2 = 12.4$ feet

$H_o' = H_b = 0.78 \times 12.4 = 9.67$ feet

$T^2 = \frac{9.67}{0.22} = 44.0$ seconds

$T = 6.6$ seconds

Saville notes that effective width of the horizontal berm is about 50 feet. The Dutch indicate one-quarter of the wave length. Based on the latter method:

$\frac{Lo}{4} = \frac{5.12}{4} T^2 = \frac{5.12}{4} \times 44 = 56$ feet, say 50 feet

Rise to top of berm = 2 + 10 = 12 feet

Effective horizontal distance to crest section toe = 84 + 50 = 134 feet

Assume R = 5.2 feet (5.6 feet above berm)

Slope = $\frac{12 + 5.6}{128 + (5 \times 5.6)} = \frac{17.6}{162} = 1{:}9.2$

From Figure 3-2 of TR-4, $\frac{R}{H_o'} = 0.53$

R = 0.53 x 9.67 = 5.1

Reiterate with R = 5.1 (5.5 feet above berm)

Slope = $\frac{12 + 5.5}{128 + (5 \times 5.5)} = \frac{17.5}{155.5} = 1{:}8.9$

From Figure 3-2 of TR-4, $\frac{R}{H_o'} = 0.53$

R - 0.56 x 9.67 = 5.1

Apply a correction of 3-1/2% from Figure 3-11 of TR-4

Final R = 5.3 feet (5.7 feet above berm)

With runup calculated as 5.3 feet, the maximum water level caused by the design hurricane surge is determined in TABLE A-4.

TABLE A-4. MAXIMUM WATER ELEVATION FOR DESIGN HURRICANE SURGE COINCIDENTAL WITH MEAN HIGH TIDE

Item	Feet
Wind set-up	7.3
Barometric rise	1.1
Astronomical tide	2.0
Runup	5.3
Maximum water elevation above mean low water	15.7

From TABLE A-4, the minimum crest elevation to prevent overtopping is 15.7 feet above mean low water. To allow for adjustments in slope and erosion, a crest elevation of 16.0 feet above mean low water and a crest width of 25 feet are selected.

APPENDIX B

A BRIEF CHRONOLOGY OF THE KATAMA BAY BARRIER BEACH

YEAR	REMARKS
1776	An opening was shown on the maps of Des Barres similar in appearance to the opening in 1846.
1846	See shoreline change map. Located next to Chappaquiddick Island, the opening was about 2, 000 feet wide and contained two small islands.
1856	The barrier beach lapped the south shore of Chappaquiddick Island to form an east-west inlet channel 3, 000 feet long and 500 feet wide. After a major storm, an opening 1, 400 feet wide appeared in the middle of the beach. Shortly after the new opening occurred, the easterly opening closed.
1869	The remaining opening migrated to the east and closed during a severe storm. For the first time in many years the beach became continuous from island to island.
1872	Congress appropriated $20, 000 to re-open a passageway through the beach from the harbor to the ocean. Surveys made by Professors Mitchell and Whiting of the Coast Survey showed considerable shoaling in the southerly end of Katama Bay.
1873	Dredging work was undertaken, but the passage was closed by a heavy storm before it could be completed, and the work was abandoned. A great deal of information concerning Katama Bay and this project is given in Appendix X of the Annual Report of the Chief of Engineers for 1874.
1874	Money remaining from the ill-fated Federal project was used to make a survey of Edgartown Harbor to determine the effects of the closure of Katama Bay. No significant shoaling in the entrance to the inner harbor was detected. Discussion of the survey is given in Appendix AA of the Report of the Chief of Engineers for 1875.

YEAR	REMARKS
1886	An opening about 1, 100 feet wide broke through the middle of the beach. See shoreline change map.
1887	From the shoreline change map, the opening grew to a width of 1, 800 feet and migrated about 1, 000 feet to the east.
1889	Shoreline change map shows breach migrated to Chappaquiddick Island and grew to 2, 400 feet in width. An island about 1, 300 feet long remained just inside.
1891	The beach was broken into a series of islands by three breaches. See shoreline change map.
1897	A single breach 1, 000 feet wide remained next to Chappaquiddick Island. See shoreline change map.
1908	An opening which existed at this time was closed by the action of winds and tides.
1915	A survey of the harbor and entrance by the State showed the opening to be closed.
1919	Opening of a passageway was attempted by local fishermen, but weather conditions closed it at midnight of the day it was completed.
1920	A petition was filed with the State to make Katama Bay a harbor of refuge. A dredged inlet was proposed through the beach to provide quick access to the fishing grounds and to vessels in distress in the Atlantic. It was also contended that lack of water circulation with no inlet was detrimental to shellfish growth.
1921	A channel was dug across the middle of the beach by State and local forces using men and teams. Shortly after completion, it had grown to a width of 500 feet and eventually reached a width of 2, 000 feet.

1924	The beach migrated some 3, 000 feet to Chappaquiddick Island where the width was narrowed to 300 feet.
1934	Southern entrance to Katama Bay was closed, or nearly so.
1938	The "Great New England Hurricane" struck September 21.
1942	Opening was still against Chappaquiddick Island, but was considerably larger. It was divided by a 1, 000-foot wide island into two 1, 000-foot wide passages.
1948-49	Shoreline change map shows a 500-foot wide opening oriented east-west along the south shore of Chappaquiddick Island.
1954	Hurricane Carol struck August 30-31. In November, an opening 400-500 feet wide was observed by a State engineer about one-half mile east of the westerly end of the spit. Local residents complained of terrific tides in Katama Bay.
1958	Coast & Geodetic Survey Chart 346, revised 8/25/68, shows 2, 500-foot opening in the middle of the barrier.
1960-61	An aerial photograph taken in December 1960 shows breach about the same width as above, only more easterly towards Chappaquiddick Island.
1964	Boat sheet of the Coast & Geodetic Survey ship WHITING shows a 1, 000-foot breach about 1, 500 feet west of Chappaquiddick Island.
1966	Aerial photo shows 1, 000-foot breach 800 feet west of Chappaquiddick Island.
1967	Aerial photo shows beach bar lapping the island, leaving a 500-foot wide inlet channel running east-west.

APPENDIX C

REPORT OF
U. S. FISH AND WILDLIFE SERVICE

APPENDIX C

U. S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
U. S. Postoffice & Courthouse
Boston, Massachusetts

June 19, 1968

Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This is our conservation and development report on fish and wildlife resources related to the navigation improvements for Edgartown Harbor (Dukes County), Massachusetts. The study is authorized by a Resolution of the Senate Committee on Public Works adopted February 29, 1960. This report was prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 inc.), in cooperation with the Massachusetts Division of Marine Fisheries and Division of Fisheries and Game and has their concurrence as indicated by letters dated June 11, 1968 and June 10, 1968, respectively.

DESCRIPTION OF PROJECT AREA

Edgartown Harbor is at the northeast end of Martha's Vineyard Island, which lies off the south coast of Massachusetts. The Outer Harbor is exposed to Nantucket Sound to the north and has depths of 20 to 30 feet. The Inner Harbor is well sheltered, with depths up to 30 feet. Most of the waterfront facilities are on the west shore of the Inner Harbor. Depths in the Outer and Inner Harbors are considered adequate for navigation.

The Inner Harbor expands southward into Katama Bay, a wide shallow lagoon approximately one mile long and 1½ miles wide. Katama Bay is virtually separated from the Atlantic Ocean on the south by a barrier beach or dunes, however a breach in the barrier beach connects the bay with the ocean.

The principal navigation problem is related to strong tidal currents which at times create anchorage and mooring difficulties and numerous accidents in the harbor. The currents are caused by the tidal difference between the north and the south sides of the island. The difference of 1.2 feet in mean

tidal range and the 2 hours and 2 minutes time lag sometimes results in a two-foot head of water between the two locations. These problems were most serious at the time the studies were initiated in 1960. At that time, the breach in the barrier beach across the south side of Katama Bay was directly south of the harbor at Edgartown and some 2,000 feet wide. The barrier beach has a history of recurring breaching, the breach moving from west to east. Today the breach is at the east end of the barrier beach at Chappaquidick Island and the currents in the harbor are 20 and 30 percent less than previously.

DESCRIPTION OF THE PROJECT

We understand that the improvements under consideration are the modification of the barrier beach to prevent further breaching, and the provision of additional anchorage for recreational boating at Edgartown Harbor.

The barrier beach will be dealt with in one of the following ways: (1) raising and widening the barrier beach from the main island of Martha's Vineyard to Chappaquidick Island; (2) same as (1), but retention of existing breach allowing it to seek self-stabilization or natural closure; or (3) same as (1), but with stabilization of an opening about 500 feet wide at the east end involving a jetty and system of groins.

We understand that material needed for barrier dune stabilization will be taken from within Katama Bay.

FISH AND WILDLIFE RESOURCES

Without the project

Katama Bay is used extensively by migrating and wintering waterfowl for feeding and resting purposes.

Common fish species in the vicinity of the project are striped bass, bluefish, Atlantic mackerel, pollock, winter flounder, summer flounder, and scup. Striped bass and bluefish are the most important sportfish and constitute an important segment of the sport fisheries on Martha's Vineyard as well as in nearby Massachusetts and Rhode Island waters. During their seasonal runs, "stripers" and "blues" are usually caught by fishermen along the beaches of Martha's Vineyard including the barrier beach and the breach to Katama Bay. Several species, particularly the winter flounder, are caught in Katama Bay; however, fishermen favor surf fishing over fishing in the Bay.

Historically all of Katama Bay lying within the study area shown on plate I had good to excellent hard clam habitat. In 1907 the barrier beach extended from Martha's Vineyard to Chappaquiddick Island. In a report to the Massachusetts Commissioners of Fisheries and Game (1909) the writer stated that the finest "little neck" (preferred small size hard clams) fishery in Massachusetts is found in Katama Bay. At that time the most productive grounds were situated in the lower part of Katama while quahogs were also found in Edgartown Harbor and in Cape Poge Pond, the total area comprising 1,800 acres. The 1907 hard clam production was given as 20,000 bushels and engaged about 70 shellfishermen.

Today, virtually no clams are harvested in Katama Bay on a commercial basis, not because the bay has no clams - it has both clams and scallops - but because most of the good shellfish habitat is in water over eight feet deep and special equipment is needed to operate at this depth. The amount of this habitat (shown on plate I) is too small to attract those who are equipped to operate in deep water. Clamming for the small operator on Martha's Vineyard is much more productive in Cape Poge Pond.

The principal reason for the loss of the clam habitat in Katama Bay is the recurring and migrating breaches in the barrier beach. When the breach is wide and located in the midsection of the barrier beach, great quantities of sand move into the bay while tidal currents keep shifting the sands about. Shifting sands prevent the establishment of good clam habitat, and in some areas the accumulated sands have created areas so shallow as to be of negligible value for shellfish. Under without-the-project conditions, the breaching can be expected to continue and the shellfish harvest will remain almost negligible over the life of the project.

With the Project

Increasing the anchorage space for recreational boating in Edgartown Harbor will neither damage the fish and wildlife resources nor will it provide opportunities to enhance these resources.

Maintaining a stable barrier beach between the ocean and Katama Bay will benefit the shellfishery to a considerable degree. There will be no significant difference in benefits whether the present breach at the east end of the barrier is permanently closed or left open (either stabilized or left to natural closure or self-stabilization). The important thing is to prevent any breaching elsewhere. A relatively small east-end breach will create shifting sands in only a local area near the breach.

Stabilization of the barrier beach will result in upgrading a minimum of 500 acres of the negligible to low value shellfish habitat. The stabilized bottom will become moderate to high value habitat. From the approximately 200 acres of negligible value shellfish habitat in Katama Bay (plate I), it is expected that some of this habitat, all of which is exposed at low tide, will be dredged and the material used to stabilize the barrier beach.

Wherever it is dredged to a depth of four to ten feet, moderate to high value shellfish habitat will be created. It is estimated that at least 70 acres of new habitat will be developed in this manner, making a total of 570 acres of improved shellfish habitat with the project. A considerable portion of the new habitat created by dredging will convert flats of negligible value to shellfish to habitat of moderate to high value. The loss of some low grade habitat due to barrier beach widening will be insignificant in comparison to a greater acreage of much better habitat that will be created.

The increased production on an area of 570 acres added to the existing moderate to high value habitat will be of sufficient magnitude to make it feasible for commercial shellfishermen having equipment needed for deep water fishing to operate in Katama Bay. There will continue to be some non-commercial shellfishing in the bay, but for all practical purposes, the entire area will be commercial in nature. The principal reasons for this are (1) the relatively deep water found in the bay is advantageous to large scale commercial fishing, but discourages the family-type of shellfishing; and (2) the relative inaccessability of the area to the general public will further encourage the development of a commercial fishery.

It is conservatively estimated that within five years after project completion the improved clam habitat will be capable of sustaining the average maximum yield of shell fish annually. It is expected that within ten years after project completion a sufficient number of shellfishermen will be operating in Katama Bay to maintain an average annual production of 200 bushels of hard clams (harvested principally as "little necks") and 50 bushels of bay scallops per acre over the remaining life of the project. Based on an ex-vessel price of $14 per bushel for clams and $8 per bushel for scallops an average acre will produce approximately $3,200 worth of shellfish; therefore, the annual project benefit to the shellfishery will have a minimum gross value of $1,800,000 (based on the restoration of about 570 acres of shellfish habitat).

The project will also benefit the waterfowl population and increase the utilization of Katama Bay by migrating birds since a stabilized bottom will be highly productive of organisms upon which waterfowl feed.

DISCUSSION

The selection of a disposal site for dredged material from anchorage enlargement in Edgartown Harbor should be coordinated with the Massachusetts Division of Marine Fisheries and this Service.

Over the years the Massachusetts hard clam landings have fluctuated but the overall trend has been upward. More significantly, the average prices have continued to rise, indicating the increasing demand for clams which generally exceeds the supply. Consequently, any increase in clam bed acreage, particularly beds that lend themselves to large-scale commercial harvesting methods, is expected to be fully utilized.

The increased acreage of improved clam beds in Katama Bay, following project construction, will materially benefit the entire island through increased employment. Today the island is primarily dependent on its visitor-based recreation, thus the majority of permanent residents are engaged in occupations which cater to the recreational trade. With the close of the recreation season (after September) most of these people must find work; however, since off-season employment is very scarce, many residents are forced to subscribe to unemployment compensation.

CONCLUSIONS AND RECOMMENDATIONS

We conclude that stabilization of the barrier beach (regardless of whether or not an opening is retained at the east end) will result in the re-establishment of a significant commercial shellfishery. Such a fishery would contribute materially to year-round employment, thus benefiting the entire island.

It is recommended:

1. That the selection of a disposal site for material removed from Edgartown Harbor for anchorage enlargement be coordinated with the Massachusetts Division of Marine Fisheries and this Service.

2. That the location and dimensions of borrow areas in Katama Bay be coordinated with the Massachusetts Division of Marine Fisheries and this Service.

Please advise us if there are any changes in your project plan so that we can prepare a new report, if necessary.

Sincerely yours,

Thomas A. Shrader

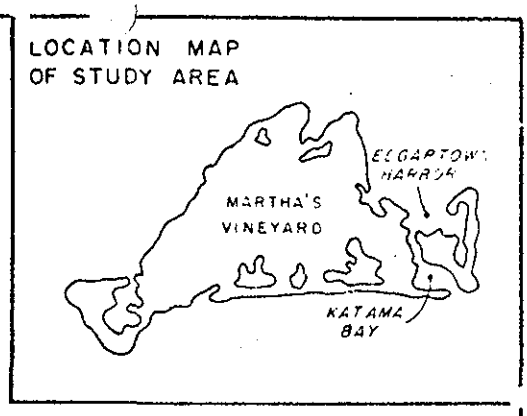
Acting Regional Director
Bureau of Sport Fisheries & Wildlife

John L. Harrett

Regional Director
Bureau of Commercial Fisheries

PLATE - I
EDGARTOWN HARBOR
MASSACHUSETTS
SHELLFISH DISTRIBUTION

Scale 1:20,000



LEGEND

- PERIPHERY OF FISH AND WILDLIFE STUDY AREA.
- EXISTING MODERATE TO HIGH VALUE SHELLFISH HABITAT
- EXISTING NEGLIGIBLE TO LOW VALUE SHELLFISH HABITAT WITH POTENTIAL FOR MODERATE TO HIGH VALUE IF OUTER BARRIER IS CONSTRUCTED
- EXPOSED AT LOW TIDE, NEGLIGIBLE VALUE SHELLFISH HABITAT. HAS POTENTIAL FOR MODERATE TO HIGH VALUE IF OUTER BARRIER IS CONSTRUCTED AND THESE AREAS DREDGED TO A DEPTH OF 4 TO 10 FEET BELOW MEAN LOW WATER

APPENDIX D

COMMENTS OF OTHER AGENCIES, STATE AND TOWN

APPENDIX D

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
240 Highland Avenue
Needham Heights, Massachusetts 02194

November 7, 1967

Mr. John Wm. Leslie
Chief, Engineering Division
U. S. Army Engineer Division
New England Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Refer to:NEDED-R

Dear Mr. Leslie:

This is in response to your letter of October 6, 1967, requesting comments on the navigation plan being considered by your office for Edgartown, Massachusetts.

The plan as outlined is intended (1) to eliminate or reduce the influence of tidal surges presently being experienced in the Edgartown Harbor-Katama Bay waterway separating Martha's Vineyard and Chappaquiddick Island and (2) to provide additional anchorage at Edgartown Harbor. The elimination or reduction of tidal surges would be accomplished by either of the following plans: (a) raising and widening the barrier dunes on the southern side of Katama Bay to prevent breaching, including closing the existing breach; (b) same as (a) but with the retention of the existing breach left to seek natural closure or self-stabilization; or (c) same as (a) but with stabilization of an opening about 500 feet wide at the east end, involving a jetty and a system of groins along the barrier. Additional anchorage in the area would be provided by extending the present anchorage at Edgartown Harbor in a northeasterly direction.

Investigations by our staff indicate that the present population abutting this waterway is approximately 1,400 and that this number can approach 5,000 during a summer weekend. At present there is approximately 500 boats in the Edgartown recreational fleet.

The Edgartown Harbor-Katama Bay waterway is presently receiving the raw sewage of an undetermined portion of the population through numerous private and municipal outlets as well as from the flush toilets of the permanent-boating fleet.

The waterway under consideration is presently an open shellfish area. Direct harvesting of shellfish products is carried on in these waters throughout the year. Records show that during 1966 approximately 125 bushels of bay scallops and 380 bushels of quohogs were harvested commercially from these waters.

The flushing action that is taking place in this area as a result of the natural openings to the sea at Edgartown and Nortons Point on the south side of Katama Bay is undoubtedly a major reason why the raw discharges described above have not degraded the present water quality sufficiently to require the closing of the productive shellfish beds located in the waterway.

As part of the requirements of the Federal Water Pollution Control Act, the State of Massachusetts has recently completed the classification of all of the interstate, intrastate and coastal waters of the Commonwealth. These classifications have been approved by the Secretary of the Interior and are now considered to be federal standards. The waters under consideration have been assigned an SA classification which requires the upgrading and continued maintenance of these waters at the highest level of quality. The waters must be suitable at all times for various uses including bathing, shellfishing, fish and wildlife propagation and recreational boating. Implementation plans, also a part of the standards program, call for the construction of a municipal sewerage system including a secondary treatment plant. This system, however, will only serve the built-up portion of Edgartown and is scheduled to be in operation during 1972. This plant will probably use a subsurface method of effluent disposal and would not discharge directly in the waters under consideration.

Analysis of the preceeding factors indicates that both present and future water quality problems may occur in the Edgartown Harbor-Katama Bay waterway as a result of the combined effect of (a) the present raw sewage discharges; (b) a substantial increase in a recreational boating fleet with flush toilets; and (c) the complete or partial elimination of the natural flushing action presently being experienced in the area.

In order to prevent both present and future water quality problems in this waterway and at the same time carry out the intended improvements, this office is of the opinion that the existing natural breach located at the south side of Katama Bay should be left open until the proposed Edgartown municipal sewerage system including the secondary treatment plant is in operation. At that time a study could be made to determine if the breach could be eliminated without having a detrimental effect on the legitimate water uses or water quality. In addition, if additional anchorage is provided, consideration should be given to providing for the storage and treatment of sewage from boats having toilets. This might be done by requiring that boats with toilets using this anchorage be equipped with retention tanks. Sewage from these tanks could then be discharged by pumping at a central point.

As a result of this review and study, this office concludes that the use of either plan (b) or plan (c) as presented in your letter of October 6, 1967 and cited in the opening paragraphs of this letter would result in minimal effects on water quality. Development of plan (a) would probably result in significant water quality degradation. Further evaluation of this

plan can be made after the construction of pollution control facilities for homes and boats, if additional navigational improvements are required at that time.

We appreciate the opportunity to review this proposed project.

Sincerely yours,

Walter M. Newman JJC

Walter M. Newman, Chief
New England Comprehensive
Program

APPENDIX D

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
128 N. BROAD STREET
PHILADELPHIA, PENNSYLVANIA 19102

IN REPLY REFER TO:
D64

September 11, 1968

Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

As you requested in your letter of July 5, 1968, we have investigated the recreational aspects of the navigation improvements being considered for Edgartown Harbor, Massachusetts. These improvements were listed in a letter dated October 6, 1967.

We feel that stabilizing the barrier dunes at Katama Bay, either with or without a permanent opening at the east end, would have a beneficial effect on the quality of recreational boating at Edgartown Harbor. This would come from lessening the adverse tidal effects caused by natural breeching of the dune. Aside from an improvement in quality, we can find no other significant recreational benefits that would accrue from such stabilization. We have checked with the U.S. Coast Guard and other sources for some tangible indication of increased safety which might result from the proposed impoundment. Our search has failed to produce records which could be used to evaluate this aspect. If you have evidence to support the contention that improved safety and increased recreational boating will result from stabilization of the dune, we will be pleased to consider the matter further.

Sincerely yours,

Rolland B. Handley
Regional Director

By: Earl C. Nichols
Earl C. Nichols

APPENDIX D

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

REGIONAL OFFICE
Region I
John Fitzgerald Kennedy Federal Building
Boston, Massachusetts 02203

November 13, 1968

Mr. John Wm. Leslie
Chief, Engineering Division
NED, Corps of Engineers
Department of the Army
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Thank you for your letter of 30 October 1968 concerning the proposed navigation improvement of Edgartown Harbor, Massachusetts, and the opportunity to comment thereon.

It is understood that the problems which should be solved by the plan of improvement are as follows:

(1) A navigation problem at Edgartown Harbor because of very strong tidal currents.

(2) Insufficient anchorage in Edgartown Harbor for recreational fleets.

(3) Shellfish producing areas are hurt by sand entering into Katama Bay, what were once good quahog producing areas are now practically non-productive.

It is further understood that problems (1) and (3) are caused by the periodic breaching of the natural sand barrier bar extending along the south side of Katama Bay. The plans of improvement which have been developed to correct these difficulties would provide for raising and widening the barrier bar to prevent further breaching and to provide additional anchorage at Edgartown Harbor. Specifically, our comments regarding these proposals are:

1. Development of Local Commercial Shellfish Industry:
It is noted that the United States Fish and Wildlife Service has reported that (a) if future breaching is prevented, and (b) if shoal areas in Katama Bay are dredged to depths of 4 to 10 feet, one result would be an enhancement of the commercial shellfish industry in the Bay.

We concur in this opinion, are much in favor of improving the shellfish industry and thus support the proposed plan of improvement. But it is also understood that although the proposals do not formally call for dredging the shoals of Katama Bay, this actually would be done to depths of 4 to 10 feet in order to provide the material for constructing the barrier bar. If this is so, there could then be a shellfish growing area.

2. Proposed Sewage Treatment Plant at Edgartown:

It is noted that the Federal Water Pollution Control Administration reports that its requirements call for construction of a secondary sewage treatment plant in Edgartown by 1972. If the outfall pipe will discharge into the marine environment, then consideration must be given to its location, so as to least affect the shellfish growing areas. F.W.P.C.A. observes that the natural breach at the east end of the barrier bar should be left open until a study can be made to determine whether the closing of this breach could be eliminated without the sewage treatment plant outfall pipe having a detrimental effect on the legitimate water quality. We believe that a determination of the potential hazards to Katama Bay from said sewage treatment plant and outfall should be made as far as possible before the works are built. It is doubted that a narrow breach at the east end of the barrier would do much to offset any pollutional loads which might occur in Katama Bay. This problem has been discussed with F.W.P.C.A. who advised us that the treatment plant may include a final sand filter which would eliminate an outfall. In any event, the pollution hazard should be designed out of the works so that there will be no threat to the future shellfish of Katama Bay, assuming that the outfall pipe discharges into the coastal waters. At present, the Massachusetts State Department of Health has not classified any of these coastal waters as "prohibited or restricted shellfish areas" but a sanitary survey of the area has been completed recently and possibly some change in classification may occur.

3. Additional anchorage in Edgartown Harbor:

It is noted that the plan of improvement also calls for additional anchorage for water craft at Edgartown Harbor. This will increase the boat population in this area. As stated in previous comments on Corps of Engineers projects, the waters at points of boat congregation may be subjected to intensive boat waste discharges resulting in pollution of the water and underlying shellfish beds. Also, boat occupants may engage in various water contact sports such as swimming, fishing, skindiving, and shellfishing. Partying and boat cleaning may occur. The extent and intensity of pollution from boats are a governing factor when shellfish growing areas are classified by the State shellfish control agency.

Therefore, we concur with F.W.P.C.A.'s request that consideration be given to providing for the storage and/or treatment of sewage from boats having toilets if additional anchorage is provided. It is also recommended that some system for monitoring boat pollution be provided, especially during the boating season.

Summary:
In summary:

(1) We would like to see the shoal areas of Katama Bay dredged so that a commercial shellfish industry could develop.

(2) We support the proposed plan of improvement since it will prevent future breaching of the sand barrier bar thereby permitting the growth of a shellfish population in Katama Bay.

(3) Advance consideration must be given to the location, with respect to shellfish growing areas, of any sewage treatment plant and outfall pipe if a marine environment discharge is selected.

(4) The natural breach at the east end of the barrier bar should be left open until a study can be made to determine the net effect upon the ecology of the Bay.

(5) We concur with F.W.P.C.A.'s request that consideration be given to providing for the storage and/or treatment of sewage from boats having toilets.

(6) We also suggest that the plans be made to monitor the proposed boat anchorage area so that steps may be taken to protect the shellfish which may grow in Katama Bay.

Sincerely yours,

Floyd B. Taylor

Floyd B. Taylor
Regional Program Chief
Water Supply & Sea Resources Program
Public Health Service, ECA

APPENDIX D

DEPARTMENT OF TRANSPORTATION

UNITED STATES COAST GUARD

Address reply to:
COMMANDER (o-1)
First Coast Guard District
J. F. Kennedy Federal Bldg.
Government Center
Boston, Mass. 02203
TEL: 617 223-3634

3260
7 November 1968

From: Commander, First Coast Guard District
To: Division Engineer, New England Division,
U. S. Army, Corps of Engineers

Subj: Plan of Improvement under consideration for Edgartown Harbor, Martha's Vineyard, Massachusetts

Ref: (a) CofE ltr NEDED-R of 30 October 1968

1. Subject plan has been reviewed, and it has been determined that no new aids to navigation will be required.

H. A. CAMPBELL, JR.
By direction

The Commonwealth of Massachusetts
Department of Public Works
Office of the Commissioner
100 Nashua Street, Boston 02114

April 29, 1969

Frank P. Bane, Colonel
U. S. Army, Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Bane: Re: NEDED-R

I have reviewed your basic design plan for the proposed co-operative navigation improvement at Edgartown Harbor and I am pleased to learn that such an extensive improvement can be accomplished at such small cost. The north entrance channel deepened to seventeen feet under the existing project will certainly encourage increased use of the proposed well protected mooring basin, dredged to six feet. The dual benefits accruing to the shellfish industry, due to construction of a dike at the south limit of Katama Bay, will have a substantial effect on the economy of not only Edgartown but, indeed, of the entire island of Martha's Vineyard.

For the above reasons, I am enthusiastically in favor of the implementation of this project, particularly in view of the minimal local cost contribution.

As you know, we have no means of forecasting the deliberations of our legislative bodies, but in view of the fact that the General Court authorized us to participate in a co-operative project at Edgartown (Chapter 592, Acts of 1966, Massachusetts General Laws) I feel reasonably certain that funds for local cost participation will be appropriated. It is assumed that the Town of Edgartown will contribute its proportionate share of the funding and provide the required lands and agreements as spelled out in the authorizing statute.

Very truly yours,

Robert S. Foster

ROBERT S. FOSTER
ACTING COMMISSIONER

TOWN OF EDGARTOWN
OFFICE OF
SELECTMEN -- ASSESSORS
HEALTH

TELEPHONE:
SELECTMEN } 627-4033
ASSESSORS }
P. O. Box 158
EDGARTOWN, MASSACHUSETTS

May 12, 1969

Colonel Frank P. Bane
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

RE: NEDED - R

Dear Colonel Bane:

On May 6, 1969, the Board of Selectmen held a public hearing for the purpose of acquainting the inhabitants of the Town of Edgartown with the proposed plan of improvements to Edgartown Harbor, Katama Bay, and South Beach. Your letter was read in its entirety and explained in detail. Those attending the hearing, along with the Board of Selectmen, felt that the proposed improvements were adequate to meet the navigational needs of local interests, would restore the commercial shellfish industry of Katama Bay, and that they would be willing to comply with the items of local cooperation and participation in said proposal. The response to all that was discussed was enthusiastic.

The Town of Edgartown would be willing to meet their cash contribution towards such a project in addition to the following:

a. Maintain and operate a public landing at Edgartown Harbor with berthing depths alongside commensurate to the anchorage depth;

b. Hold and save the United States free from all damages which may result from the construction and subsequent maintenance of the project;

c. Provide without cost to the United States all lands, easements and rights-of-way required for construction and susequent maintenance of the project and aids to navigation;

d. Regulate the use, growth and free development of the harbor facilities with the understanding that they will be open to all on equal terms; and

e. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor by users thereof, which regulations shall be in accordance with the applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control.

NEEDED - R
Colonel Frank P. Bane

May 12, 1969

We want to thank you for all of your help and wish to inform you that we are eager to proceed with the project. We are available at any time to work towards this end.

Very sincerely,

Robert J. Carroll, Chairman
Board of Selectmen

RJC:pb

EDGARTOWN HARBOR,
MARTHA'S VINEYARD, MASSACHUSETTS

Information called for by Senate Resolution 148,
85th Congress, adopted 28 January 1958.

1. Navigation Problem.

Edgartown Harbor is located on the southeast side of Martha's Vineyard Island, the largest of a group of islands off the southern coast of Cape Cod, Massachusetts. The harbor lies between Martha's Vineyard and Chappaquiddick Island, a small island on the east. The inner portion of the harbor extends from Chappaquiddick Point southward 1-3/4 miles to Katama Bay, a wide, shallow lagoon almost completely separated from the Atlantic Ocean on the south by a long sandspit. Depths in the harbor between the Edgartown waterfront and Chappaquiddick Point range from 12 to 24 feet. An existing Federal navigation project provides for a channel 17 feet deep, generally 150 feet wide from Nantucket Sound into deep water of the inner harbor with suitable widening of the bend inside the inner harbor entrance; also, removal of the entire Middle Ground Shoal and a portion of the shoal inside and east of the inner harbor entrance to a depth of 12 feet. The existing project was completed in 1939.

The principal navigation problems encountered are inadequate anchorage space for recreational craft and strong tidal currents in the inner harbor following periodic breaching of the Katama Bay barrier beach by hurricanes and other severe tropical storms. Numerous instances of damage attributable to currents have been reported, especially in the crowded anchorage areas. To find anchorage space and avoid the currents, the larger boats are forced to anchor in the outer harbor where they are exposed to easterly and northeasterly storms.

2. Improvements Considered.

Analysis of information indicates that the currents within the inner harbor are associated with the migratory breach in the Katama Beach barrier. The currents are strongest when the opening is located in the western or middle portion of the beach. As the

easterly littoral transport moves the breach toward Chappaquiddick Island, the currents diminish because the hydraulic gradient between the Atlantic Ocean and Nantucket Sound lengthens and flattens out. Consideration was given to constructing an inner barrier across the head of Katama Bay from Long Point to Katama Point. This plan was opposed by the U. S. Fish and Wildlife Service on the basis that if Katama Bay were separated from Nantucket Sound its ecological balance would be disrupted. Littoral drift would seal off the opening in the barrier beach and the bay would become a brackish pond. Also, changes in the tidal prism within the harbor could create pollution and additional shoaling problems. Consideration was given to dredging a 39-acre anchorage within the inner harbor to 12 feet as requested by local interests. Examination of the fleet composition at Edgartown Harbor revealed that most of the boats are outboards, inboards, stern drives and small power cruisers. These craft do not need an anchorage with depth greater than 6 feet.

Three plans were considered for improving the barrier beach: (a) Building an artificial high sand dune from high ground on Martha's Vineyard to Chappaquiddick Island closing the breach; (b) same as (a) but leaving a self-stabilized opening or allowing a natural closure at the easterly end; and (c) same as (a) but artificial stabilization by means of a jetty or system of groins leaving a 500-foot wide opening at the east end.

Complete closure of the breach would result in no additional navigation benefits since the currents in Edgartown Harbor are nearly negligible when the breach is at the east end. As concerns a stabilized inlet, the high rate of littoral transport along the south shore indicates that stabilization of an opening by jetties or revetment would not be economically justified.

3. Improvement Recommended.

A plan of improvement has been developed which would provide for a 10-acre anchorage, 6 feet deep, adjacent to Chappaquiddick Point in the inner harbor and construction of a high level barrier beach (top elevation 16 feet above mean low water) extending along the southerly side of Katama Bay from the main island of Martha's Vineyard toward but not connected to Chappaquiddick Island. The estimated total cost of construction is $1,855,000. Benefits

accruing to the shellfishing industry and recreational boating interests amount to an annual total of $587,600 The benefit-cost ratio is 3.6 to 1.0.

4. Apportionment of Cost and Local Cooperation.

As the benefits to be realized are both general and local in nature, local interests would be required to share in the cost of construction. Based on the distribution of general and local benefits, the Federal share of the construction cost would be 94.6 percent or $1,755,000 and the non-Federal share would be 5.4 percent or $100,000. The improvement is recommended subject to the requirements that local interests:

a. Make a cash contribution of 5.4 percent of the cost of construction, presently estimated at $100,000.

b. Maintain and operate a public landing with berthing depths alongside commensurate to the anchorage depth;

c. Hold and save the United States free from all damages which may result from the construction and subsequent maintenance of the project;

d. Provide without cost to the United States, all lands, easements and rights-of-way required for construction and subsequent maintenance of the project and aids to navigation;

e. Regulate the use, growth and free development of the harbor facilities with the understanding that they will be open to all on equal terms; and

f. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control.

5. Discussion.

Local interests have been consulted and have approved the recommended plan. They have indicated also that the requirements of local cooperation will be fulfilled. Proposed local cooperation is consistent with similar projects. The project modification is economically justified based on data in the report and criteria for similar projects.